



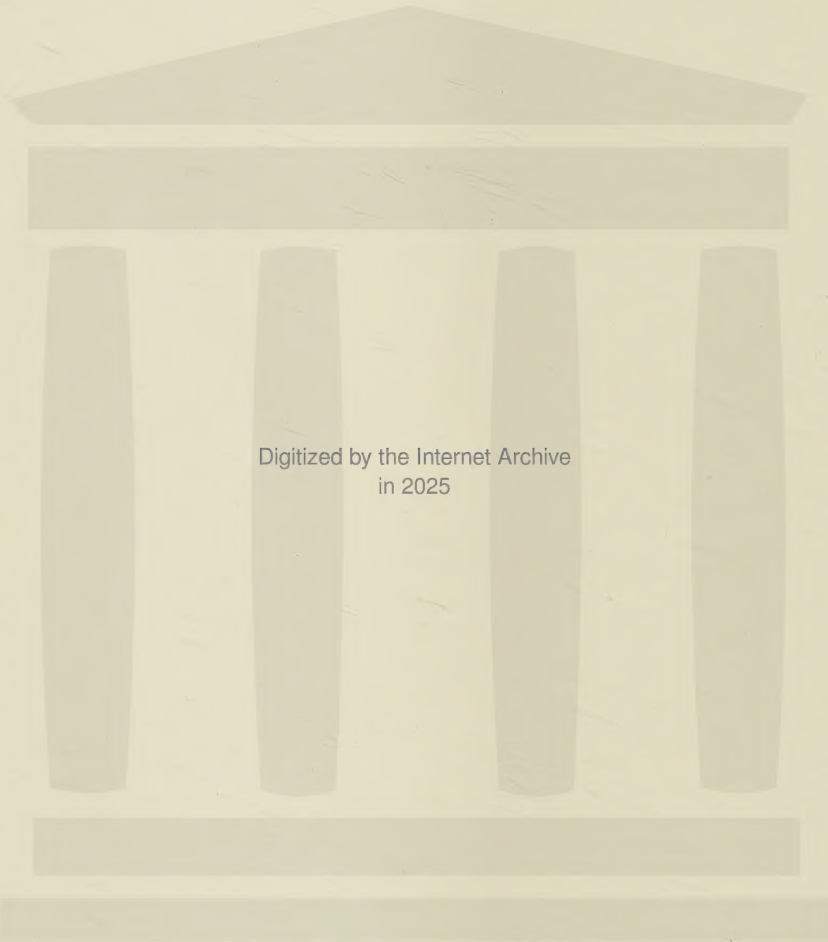
NORTHERN REGION OF NIGERIA

**Annual Report of the Ministry of
Agriculture of the Northern Region of
Nigeria for the year
1956-57**

GOVERNMENT PRINTER, KADUNA



**Annual Report on the Department of Agriculture
Northern Region of Nigeria 1956-57**



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FOREWORD

BY

THE HONOURABLE ALHAJI MOHAMMED MUSTAFA, M.H.A.,
MINISTER OF AGRICULTURE, NORTHERN REGION

The rains in 1956 were, unfortunately, unsatisfactory. Planting rains started late and there was intermittent drought and these two factors had an adverse effect on both food and cash crops. An intensive propaganda campaign, however, led to a large increase in the planting of yams and cassava, crops which were not so seriously affected by the poor rains. This campaign prevented the possibility of serious food shortages in certain areas.

In my Foreword to last year's annual report I commented on the improvement in the Senior Staff position. I am glad to be able to report that this improvement has continued. Unfortunately, there is still a grave shortage of trained junior staff and this problem must be tackled with vigour.

Despite difficulties, the year has been one of solid achievement and progress and I should like to congratulate all officers on their endeavours.

Kaduna,

October, 1959

Part I—General

INTRODUCTION

The Northern Region forms about three quarters of the total area of Nigeria, and is divided into twelve provinces with a total area of 281,782 square miles and an estimated population in 1956 of 18,128,000.

The principal exports from the Region and their values during the calendar year 1956 were as follows:—

<i>Commodity</i>	<i>Unit</i>	<i>Quantity</i>	<i>Value (£)</i>
Groundnuts	Ton	448,084	27,764,351
Tin	„	13,364	7,297,490
Raw cotton, other than linters	„	27,852	7,112,834
Hides and skins	„	8,545	3,024,608
Columbite	„	2,406	1,762,135
Benniseed	„	22,195	1,391,893
Cotton seed	„	37,338	950,629
Soya beans	„	10,200	369,139

The wide range of conditions in an area ranging over more than 7° of latitude, between 6° North and 13° North, at elevations rising to over 6,000 feet and containing six main tribes and many lesser ones, makes the agricultural development of the area a task of formidable magnitude.

Soils are on the whole of low inherent fertility, they have long been abused and overworked and, in the heavier rainfall areas, have been badly leached.

The climate is one of extremes. North of latitude twelve, the dry season may last for eight months, to be succeeded by a wet season of thunder storms, some accompanied by torrential rain. Further south, conditions are not quite so harsh climatically, though there is an unpredictable tendency to an equatorial double rain season which makes the August rainfall unreliable.

Cultivation is done mainly by hand and yields of upland crops are low. Land is allowed to go out of cultivation to bush fallow when it is no longer able to produce a reasonable crop. With increasing demands and the pressure of growing populations, the period of fallow in some areas is becoming inadequate for recovery, and deterioration is rapid and severe.

The idea of maintaining fertility by the use of manure and fertilisers is gaining ground, but the idea of planting grass with legumes as a crop to aid land recovery and to provide some return during the fallow period, is as yet in its infancy.

This is the general background against which the economic progress of the Region must be measured—a predominantly subsistence economy, where the food requirement of the family is still the main factor, being gradually geared to a monetary economy involving internal trade, exports and imports.

STAFF

2. Shortage of trained staff is still a major limiting factor to agricultural development within the Region, but an improvement was shown by the appointment of twenty-four Senior Service Staff.

The recruitment of suitable junior staff remains a major problem. The year showed only an increase of ten and there remains a total of 308 vacancies in all grades, to complete the establishment.

Much direct agricultural work now devolves upon the Native Administration agricultural departments: but here also the general standard of education and technical ability of the staff is too low, and supervision is inadequate.

This shortage of suitably qualified staff, both office and technical, means that much of the time which experienced officers should be spending on technical, advisory and supervisory work must of necessity be devoted to routine work and administration.

A summary of the establishment apart from staff posts is given below.

<i>Post</i>	<i>Establishment</i>	<i>No. 1-4-56</i>	<i>No. 31-3-56 1-4-57</i>	<i>Vacancies</i>
SENIOR SERVICE:				
Principal Agricultural Officers	13	1	3	10
Senior Agricultural Officers	10	8	8	2
Agricultural Officers	45	23	31	14
Agricultural Superintendents	90	46	53	37
Irrigation Engineers	11	6	8	3
Agricultural Engineers	5	2	3	2
Mechanic Demonstrators	12	10	10	2
Specialist Officers	33	12	16	17
JUNIOR SERVICE:				
Assistant Agricultural Officers, Grade I ...	16	14	15	1
Assistant Agricultural Officers, Grade II and III	41	20	27	14
Senior Agricultural Assistants	15	11	11	4
Agricultural Assistants, Grade I	30	9	9	21
Agricultural Assistants, Grade II and III ...	198	87	79	119
Irrigation Surveyors, Grade II and III ...	16	10	9	7
Field Overseers, Grade I and II	175	128	133	42
Irrigation Overseers, Grade I and II ...	40	19	25	15

THE SEASON

3. Over the whole Region crops, both cash and food, were adversely affected by poor rains. In many areas, early rains which were followed by a period of drought caused replanting of some early crops, and in some cases up to three replantings took place.

The early cessation of the rains was detrimental to late maturing crops and resulted in yields of cotton and groundnuts well below the previous year.

FOOD SUPPLIES AND PRICES

4. With the very poor distribution and shortage of rain during the rainy season, it was feared that there might be a serious shortage of foodstuffs throughout the Region. The officers of the Department were active in encouraging the people to increase the quantity of yams and cassava planted, to offset the forecast shortage of cereals. These two crops were least affected, and the increased acreage planted did much to offset the poor yields of the other staple foods.

QUANTITY OF EXPORT CROPS

5. Below are given the tonnages bought, of the principal export crops:—

<i>Crop</i>	<i>Tonnage Purchased for Export</i>		
	1954-55	1955-56	1956-57
Groundnuts	374,627	514,073	363,253
Seed Cotton	94,745	77,335	69,425
Benniseed	15,627	18,376	15,795
Soya Beans	8,704	9,596	15,215

GROUNDNUTS

6. The reduction in tonnage purchased has been largely due to the adverse growing conditions, but an encouraging feature has been the increase in special grade nuts which can be attributed to two factors: (a) the price differential in favour of the special grade; and (b) the increase in hand-operated decorticating machines.

In Kano Province the Dambatta Multiplication Scheme, of the variety K50, completed the second phase of its four-year programme and produced 320 tons of seed for distribution next season. The value of this scheme has again been confirmed when a survey of 300 groundnut farms showed that K50 gave an increased kernel weight of 38 per cent over the local spreading varieties.

COTTON

7. The decrease of 7,910 tons purchased from the previous year was due to late planting, low rainfall in the North and the early start of the Harmattan. Adamawa, Bauchi, Plateau and Bornu increased their purchases by 621, 4,228, 240 and 405 tons respectively, but these increases were more than offset by decreases as follows: Sokoto 2,969; Zaria 5,548; Katsina 3,133; Kano 1,440; and Niger 655 tons respectively.

The quality of seed cotton marketed continues to rise and 83 per cent of the crop purchased was grade 1. This is a reflection on propaganda in the field, but this year was also aided by a reduction of insect damage.

The multiplication of the new sub-strain 26J continues in Katsina and Bauchi Provinces.

SOYA BEANS

8. The crop is concentrated in Tiv Division of Benue Province and in parts of Niger. An excellent crop was anticipated, but the adverse weather conditions caused a considerable drop in yield.

BENNISEED

9. The main crop of benniseed in Benue Province received a set-back in the first week after planting, due to drought. It made a remarkable recovery but yields were low. This was partially offset by an increased acreage under the crop, but the final purchases were down on the previous year.

As the white benniseed is commercially the most desirable type, an effort was made to improve quality by injecting five tons of pure white seed into Lafia Division, while another $1\frac{3}{4}$ tons of a high-yielding white variety was also distributed for multiplication.

CAPSICUMS

10. 250 tons were graded in the Region at the three inspection stations at Funtua, Bukuru and Kano. As capsicums must be shipped within two months of inspection, most buyers prefer to have inspection carried out immediately prior to shipping. All capsicums were passed as grade II.

TOBACCO

11. This is an important cash crop in some areas. Thus in Sokoto the Nigerian Tobacco Company paid £45,000 to farmers for 620,659 lbs. of cured leaf. Yields here vary between 280 and 520 lbs. per acre, but leaf curl is widespread, and it is hoped to introduce a close season from April to June as a control measure.

In Bornu purchases increased by over 3,000 lbs. to 10,248 lbs. and the technique of curing has shown an improvement as is illustrated by the following table.

					<i>Grade I</i> <i>percentage</i>	<i>Grade II</i> <i>percentage</i>	<i>Grade III</i> <i>percentage</i>
1954-55	...	...	...	...	26.20	50.48	23.32
1955-56	...	...	...	...	56.00	41.00	3.00

RICE

12. Rice is grown all over the Region but it has been encouraged in certain provinces through the agency of mechanical cultivation. This has been achieved largely because of the high price of the crop which, with reasonable yields, renders mechanical cultivation an economic proposition. The main centres are in Bornu, Zaria, Kano, Sokoto, Plateau, Benue, Niger and Ilorin.

Upland rice is being increasingly cultivated in Lowland Division of Plateau Province where yields of 2,000 lbs. paddy have been achieved. This crop has the added advantage of fitting into the farming system.

TREE CROPS

13. Towards the end of 1956 an expert in tree crop cultivation visited the riverain provinces and advised on ways and means of expanding tree crop cultivation. Recommendations were proposed for coffee, kola, oil palms and cocoa in Kabba, Ilorin, Niger, Benue and Plateau. These Provinces are undoubtedly marginal for these crops but nevertheless they are grown, and an increase in cultivation would assist in diversifying agriculture, in improving the nutritional standards, and may eventually play a part in the exports of the Region.

Tree crop development is long term work and its advantages not always quickly realised by the indigenous farmers. In this way apathy, lack of care and attention are major snags on the field side. Bush pests, goats and cattle increase the hazard, diseases are largely unknown factors, while fire presents the greatest risk of all.

OIL PALMS

14. Wild palms are widespread and obviously offer scope for improvement through new varieties and through better care and maintenance. As part of this programme an oil palm seed germinator has been established at Yandev in Benue, where 30,000 seeds were received from improved trees from the Eastern Region. At the end of March 39 per cent had germinated. Also from Yandev 6,200 tray seedlings were distributed to other stations in the Region.

All riverain provinces now have plantations of varying size where much valuable information and experience of the crop is being obtained.

Some idea of the potential of this crop can be obtained from Kabba Province where over £500,000 was realised from the sale of palm oil and kernels.

COFFEE

15. Production is confined almost entirely to Kabba Province, where cultivation is scattered and management leaves much to be desired. However Ilorin, Benue, Niger and Plateau have established small nurseries of robusta coffee and results are promising.

On the Mambilla Plateau of Adamawa Province arabica coffee appears to have a potential, and over 8,000 selected seedlings were sold to farmers. Establishment has been variable. In this case the limiting factor is lack of accessibility through poor communications.

COCOA

16. This crop is limited to Kabba and Ilorin Provinces, but parts of Niger and Benue may prove suitable. Over 700 tons were purchased, mostly from Kabba, but in addition an unknown quantity finds its way into Western Region markets.

KOLA

17. Work on this crop is in its infancy but nurseries and plantations have been established by all riverain provinces.

FRUIT TREES

18. Citrus, mangoes, guavas and some minor crops come under this heading, and are important from the nutritional point of view. There is undoubtedly a dearth of fruit in the Region, and demand exceeds supply.

Bornu Province leads the way in this aspect of the work, and has even reached the stage where local farmers have set up their own nurseries and successfully do their own budding. There are now over 1,000 orchards and nurseries in the Maiduguri area alone and the preference appears to be mainly for mangoes.

Over a quarter of a million trees were distributed from known nurseries, and the majority of these trees were from Bornu.

LOCUSTS

19. Immature swarms of desert locusts were reported between October 1956 and April 1957. Localised damage was done in Bornu to cowpeas and dry season guinea corn.

CATTLE MULTIPLICATION CENTRES

20. The eleven centres are now established, and the emphasis is on multiplying up the cattle for eventual sale to mixed farmers. The general level of health has been good but mastitis at Lumu in Bauchi Province, and liver fluke at Birnin Kudu in Kano Province, created temporary problems.

A start has been made with fencing and sowndown pastures with the ultimate aim of self-sufficiency in all cattle foods.

Water is a problem on one or two of the centres but this should be overcome in the near future.

There is a marked demand for female stock from mixed farmers, and it is already evident that the main theme on these cattle multiplication centres must be in female stock.

MIXED FARMING

21. The general picture is of expansion and progress. There was an overall increase of approximately 1,000 farmers taking advantage of advances from the Native Administrations, which is the basis of the scheme. This, however, does not represent the total increase over the year as many farmers are now buying their own cattle and ploughs without advances. This trend is most marked in parts of Bauchi, Kano, Sokoto, Katsina and Plateau Provinces. This is a most encouraging trend, and tends to ease the heavy financial burden which some of the Native Administrations have been shouldering with advance accounts. There is also a marked demand now for female stock which is proving very difficult to meet.

POULTRY

22. At Riyom in Plateau Province the policy for the poultry unit is the investigation into breeding feeding and management, the supply of breeding stock to other Provinces and issues to farmers in Plateau Province:—

The unit consists of:—

- (a) A native flock derived from birds obtained in Plateau Province.
- (b) A Rhode Island Red flock ex United Kingdom.
- (c) A Light Sussex flock ex United Kingdom.
- (d) A cross-bred flock obtained by crossing Rhode Island Red hens with native cockerels.

Stock on hand at 31-3-57	...	...	...	...	...	1,895
Birds distributed during the year	...	...	...	...	...	2,027
Eggs distributed for setting	...	...	...	...	...	9,847
Total egg production	...	...	...	...	...	75,757

One of the most interesting developments was the start made on breeding up the native bird. Selection was limited to body size, total egg production, and longevity. Improvement has been rapid, but much of it must be due to management.

Hatchings throughout the year varied from 40 per cent—85 per cent; the poorest being during the rains, from May to September, and the native flock giving the best hatchability percentage.

Health in the Unit was good and there was no major outbreak of disease during the year.

SOIL CONSERVATION

23. A soil conservation section of the engineering branch was formed in August with an Agricultural Officer in charge, and thought given to a land use team.

Of practical work in the field Langtang in Plateau Province showed most progress. This scheme is based on selfhelp where departmental staff peg out terraces and bunds, and the farmers construct them. Financial assistance is given in the construction of large cutoff drains, stone outlets, and the provision of tractordrawn ridging bodies which takes some of the the drudgery out of bund construction. The total area now conserved is approximately 20 square miles. Mixed farming is being established as a follow-up, and only those who can purchase their own bulls are being initiated into this new system. The standard of cattle ploughing in many cases is remarkably high. In addition fertiliser trials are being conducted as another method of stabilising the farming, and increasing fertility and yields.

Other work done during the year was at Samaru, where some 3,000 yards of terraces were built, and 1,000 yards of retaining banks added to previously prepared water courses.

On Daudawa farm a new 60 acre extension was conserved and a previous system realigned to correct water logging.

In Kano work continued on the Badume area as well as on other sites. This is being followed up with pasture establishment.

Work continued at Mokwa where the terraces discharging into water meadows are proving most beneficial.

AGRICULTURAL ENGINEERING

24. The major effort of the engineering branch is of necessity devoted to servicing the considerable amount of equipment carried by the Ministry. This essential work is carried out quietly and unobtrusively and entails much recording and office routine.

The other aspect of the engineering branch is to test and, make recommendations on machinery which may be untried in this country. This also includes new land, and cattle drawn implements. Some of the machines which were tested at Samaru over the year are listed below:—

Ransomes Conder Reversible Plough.

Ransomes Conder "Hawk" disc plough.

Fordson Major (steel wheels).

Caldwell Brush Cutter.

Ransomes Hussar Plough.

Garvie Harvester.

The results on tests were satisfactory.

In the provinces the main effort was given to ploughing and cultivations in fadamas (rice swamps). This work was popular with farmers and there was an increased demand for tractor ploughing over previous years. Owing to the fairly high cash return per acre of rice this proved an economic proposition.

Ploughing was done in many of the provinces. In Northern Zaria 239 acres were ploughed by a mobile unit of Ferguson tractors and equipment, in southern Zaria 200 acres with a Fordson County Crawler and Hussar plough.

In Benue at Lafia 872 acres were ploughed by a unit from the Shemakar Rice Scheme. This unit also ploughed 900 acres in Plateau Province.

In Bornu 970 acres were ploughed using a Caterpillar D4 and Ransomes Dragoon plough whilst the soil was moist, replaced by a Ransomes Duratrac plough when soil dried out.

The Kano provincial mechanical unit was mainly employed on land rehabilitation and road work.

MOKWA AGRICULTURAL PROJECT

25. The number of settlers was reduced during the year from eighty-eight to sixty-nine.

There was still little sign of any settler really adopting the settlement as his home and moving in with his whole family. However, a Native Authority grant of £3 for each new house built, up to a maximum of three, did encourage the development of family compounds, and during the year thirty-five huts were built.

Rainfall was light during March and April, and plantings of all crops were late. This led to the appearance of some Rosette in the groundnut crop.

Guineacorn yields were disappointing and the grain was small and light.

IRRIGATION

26. Prior to 1957 only two schemes had been constructed and put into operation. The earliest of these is the Kwarre Irrigation Scheme in the valley of the Sokoto River near the town of that name. It was constructed in 1926 and consists of 960 acres of good land which are protected from the floods of the Sokoto river by a flood protection bund enclosing the whole area. The irrigation supply is obtained from a small stream fed from Kwarre Lake. Over the years since it was constructed in 1926 it had fallen gradually into decay for a variety of reasons which included some fundamental errors in design. In 1956-57 the scheme was rehabilitated and brought back into operation but the fundamental misconceptions in the distribution system remained unresolved.

The Wuya Edozhigi Irrigation Scheme is situated in the fadama of the Kaduna River ten miles from the town of Bida, and was constructed between the years 1953 and 1957. A total area of 3,000 acres was bunded off from the river and received its supply from two small rivers brought under control at the upper and lower limits of the scheme. In the 1956-57 season about 1,500 acres were planted with rice. The area has been declared a Settlement Area under the Native Rights Ordinance and it is controlled by a Management Committee under the Bida Native Authority. A water rate of £1 is imposed under the Rules and Certificates of Occupancy have been issued to the farmers to secure their right of tenure.

The Badeggi Irrigation Scheme was constructed between the years 1953-56 and is an irrigation project with no flood protection bund. There are about 2,000 acres which can be commanded by the headworks and distribution system and in the 1956-57 season about 1,000 acres of rice were planted. This scheme has also been declared a Settlement Area and is managed by the same committee as the Wuya Edozhigi Scheme. The Federal Rice Research Station was established within this area in 1953 and seventy-five acres are now cultivated for experimental purposes.

The Loguma Irrigation Scheme was under construction during the current year and is another irrigation scheme with no flood protection as all the land to be irrigated is above flood level. It is situated in the Agaye Emirate. It is intended to declare this area a Settlement Area in due course.

The Toroko Irrigation Scheme was largely developed from an irrigation system operated by the villagers themselves and all the work was carried out by the farmers under the guidance of the Irrigation Division. All the 180 acres were planted last season and although the area has been declared a Settlement Area no water rate is charged because the farmers carry out their own maintenance and supply all the labour free for the development work.

The Duku Irrigation Scheme in Ilorin Province has been surveyed and a design prepared. Construction was started in the current year. The scheme is a gravity irrigation scheme with headworks on the Duku River. The distribution system is designed to give a supply to 2,000 acres when fully developed. The whole of the area is above the Niger floods and does not require any flood protection.

Two other schemes are being investigated in this area, namely the Echikwi Scheme of about 1,600 acres and the Egwa Scheme near Lafiagi of about 2,000 acres.

The Wurno Irrigation Scheme was under investigation during the current year and towards the end of 1957 a start was made on the construction work. The first stage of the scheme is to bund off about 5,000 acres of the fadama to give flood protection to about 3,500 acres in the first instance. Two intakes will be provided in the upstream end of the bund to provide irrigation water to the bunded area and a comprehensive distribution and drainage system will be provided. The scheme can be extended to give control over 10,000 acres eventually as experience is gained in the operation of the first stage. The objective of the scheme is to grow white rice in place of the present red rice crop, which has not such a good market, under properly controlled irrigation conditions.

The dry-weather extension to the Kwarre irrigation Scheme was also under investigation. This scheme envisages providing an irrigation supply to some 1,500 acres of fadama during the dry weather. No bunding is contemplated at the moment and experience will show if any further development is possible on these lines after construction is complete.

Tungan Kawo Drainage Control and Irrigation Scheme was being investigated during the current year. This scheme provides for the control of the floods over an area of 5,000 acres of very fertile land and for the irrigation in the first instance of some 1,500 acres of that 5,000 acres. At present some 150 acres of this land is ploughed by agricultural tractors at a fixed charge per acre. The improvement of the drainage is the most important factor in the development of the area.

An area at Guzan in Niger Province is at present being investigated with a view to assessing its suitability for the provision of an irrigation supply and flood protection. The investigation should be completed in 1957. The Bokoji Irrigation Scheme is also under investigation and it is expected that eventually some 7,000 acres will prove suitable for irrigation.

A small Irrigation Scheme on the River Tomas was under construction with a view to supplying fifty acres of fertile land with water. It is expected that vegetables will be the main crop in this area. This is the first scheme to be undertaken in Kano Province. Another small experimental scheme is being undertaken at Makoda Lake with a view to assessing the value of supplying water from a windmill driven pump.

Part II—School of Agriculture

1.—AGRICULTURAL EDUCATION

Session January 1956 to December 1956.—There were several staff changes during the session ending December, 1956 and help in the teaching of science subjects was once again given by the staff of the Nigerian College of Technology as follows:—

Chemistry—Nineteen revision periods and seven laboratory periods
Botany—Sixty-seven lecture and ten laboratory periods.

Help was also given during the session by specialist officers from the Regional Research Station.

Session Commencing January 1957.—The School now has on its staff a Science Specialist—Mr Kennedy—and he is organising the science courses so that all teaching is done by the School staff with perhaps towards the end of session some help from the Regional Research Station staff on recent developments in applied work.

All the classes on Agricultural Experimentation to the Senior Course (Assistant Agricultural Superintendent) will be given by Regional Research Station staff.

Courses Session January 1956 to December 1956.—Three separate courses were run:—

- (1) *Assistant Agricultural Officers Course.*—A two year course for selected students who had already done one year of the Agricultural Assistants Course.
- (2) *Agricultural Assistant Course.*—Two years
- (3) *Junior N.A. Course.*—Eleven months course for N.A. administration Agricultural Assistants.

Numbers taking these courses and results are set out below:—

<i>Class</i>	<i>No. at beg. of year</i>	<i>Admitted During Year</i>	<i>Qualified</i>	<i>Failed</i>	<i>Left</i>	<i>No. at end of year</i>
1. A.A.Os.	10	—	7	1	2	—
2. 1955 A.As.	18	—	16	2	—	—
3. 1956 A.As.	18	—	—	3	5	10
4. 1956 N.A. A.As. ...	31	—	28	1	2	—
	77	—	51	7	9	10

On the 7th December, 1956, the School Presentation Day was held when certificates were issued to fifty-one successful candidates. Presentation of certificates was made by the Director of Agriculture, Mr P. C. Chambers, and the Emir of Zaria addressed the Students emphasising the importance of their calling. Also on the platform was Mr C. K. Wreford, Senior Resident, Zaria.

Session Commencing January, 1957.—Again three courses are being run with the Agricultural Assistants Course and the N.A. Junior Course on the same lines as previous years.

The Senior Course is now, however, an eleven months course of training for selected Agricultural Assistants who, if they complete the course satisfactorily, will become Assistant Agricultural Superintendents.

For this session all the men on this course were selected from students who were at the School on the Agricultural Assistant Course 1950 to 1952 plus one ex Ibadan student. They all did well as students and have since been well recommended by their Agricultural Officers. Secondary Six was set as the minimum qualification, although one student highly recommended by his Agricultural Officer with Secondary V has been admitted. Owing to the comparatively high academic qualifications of the students it is intended that the course this session shall be primarily for students who will at the end of the year be absorbed into the research departments.

Student numbers for the courses for session 1957 are set out below:—

<i>Class</i>	<i>No. at beg. of Year</i>	<i>Left</i>
1. A.A.s.	9	—
2. 1956 A.As.	10	—
3. 1957 A.As.	32	4
4. 1957 N.A. J.C.	30	—
	81	4

2.—SCHOOL LIBRARY

During the period 1st April, 1956 to 31st March, 1957, a total number of 989 new books were received through the Crown Agents. These consisted of 556 books from 1955-56 Indent and the balance of 433 books from 1956-57 Indent, and brought the total number of books to 2329 up to the end of the year.

Accessions.—All new books were being accessioned as they were received.

Classification and Cataloguing.—With the help of the Regional Research Station Librarian most of both the old and new books were classified and catalogued both by Authors and Subjects. Progress with this aspect of work has been quite satisfactory.

Loan Section.—Records in this section of the library show an enormous increase in the number of books borrowed during this period, this rate of borrowing of books indicated a steady growth of interest in reading among students

The Library was being opened to both staff and students on week-days 7-9 a.m.; 10-2 p.m. and 3 to 4.30 p.m. and on Saturdays 7-9 a.m.; 10-12 noon. There was no library service on Sundays.

3.—EQUIPMENT

All the students have not yet been supplied with working and leisure clothes as a circular has yet to be issued by the Civil Secretary, Northern Region giving instruction on how N.A. students should be treated.

A circular was received September, 1956 indicating how Government students should be treated and issues have been made accordingly.

Details of issues are set out below:—

Students with Secondary IV or over received working clothes only i.e.

- Three khaki shirts
- Three pairs khaki shorts
- One pair canvas shoes
- One pair rubber shoes
- One raincoat.

Students below Secondary IV received the following in addition to working clothes:—

- Two white caftans
- Two pairs white trousers
- Two white fulas
- One pair sandals
- Two singlets
- Two pairs underpants
- One sweater.

4.—STUDENTS CLUB ACTIVITIES

Student leisure activities continued to be organised through the Student Club which is also the recognised avenue of approach to the Principal on problems concerning the whole student body.

THE FRIDAY NIGHT CLUB

An important aspect of this club continued to be a healthy centre of social intercourse for all classes of students.

Activities during the year under review consisted of Brains Trusts, Lectures, Question Time, Impromptu Speeches, Debates, etc., and Film Shows on alternate Fridays. No films were shown in the last quarter of the year owing to a temporary breakdown in the cine projector.

SPORTS

Football.—The School came top of the 2nd Division in the Zaria Football League thereby winning the Cup.

The Gibbon Cup for the Inter-House Competition was won by Baker House and the final of the Inter-Class competition resulted in a tie between the Assistant Agricultural Officers and 1956 Agricultural Assistants.

Hockey.—Practices were held but only one match was played, the School being defeated 7-1 by Government College, Zaria.

Boxing.—Boxing was started but attendance was too spasmodic for it to be considered a real success.

Athletics.—A certain amount of work was done, but unfortunately the Zaria Inter-School meeting was postponed.

Table Tennis.—A championship tournament was held in the Hostel resulting in a win for Duroslnlorum of the 1956 Agricultural Assistants.

STUDENTS EXCURSIONS

The purchase of a 3 ton lorry in 1956 enabled the School to organise educational tours during the session as follows:—

July A.A.O. and 1956 A.A. Class	Excursion to Plateau Province to see the various agricultural projects in the Province and the Veterinary Research Centre.
July 1955 A.A. Class	Excursion to Niger Province to see various centres of agricultural importance including Minna piggery, Mokwa, Kontagora etc.
November N.A. Class	Excursion to Katsina and Kano to see Farm Centres, Livestock Investigation Centres, etc.

JANUARY-MARCH, 1957

So far this period only local excursions have been arranged.

16-2-57—1957 N.A. Class visited Shika Stock Farm and the Cotton Market.

1-3-57—1956 A.As. and 1957 N.A. students visited Maigana.

15-3-57—1956 A.As. and 1957 N.A. students visited B.C.G.A. Ginnery.

5.—SCHOOL HOSTEL

During the year the following improvements were carried out:—

- (1) Replacement of kerosene lamps by electric light.
- (2) Re-roofing and re-decoration of students quarters.
- (3) Construction of internal laterite roads.
- (4) Some levelling of the Hostel area site.
- (5) Construction of drains.
- (6) As mentioned elsewhere the planting of hedges and ornamental trees and shrubs.
- (7) Allocation to each student of plots for flowers and vegetables.

Work is still necessary on some of the internal roads and also drainage, although improved, still needs attention.

6.—MAIN FARM

This farm is used mainly for demonstration work especially in mechanised cultivation.

						aces
Arable Area	...	...	...	...	...	35
Pasture Area	...	...	...	...	...	36.5
Reserve Area	...	...	...	...	...	34.5
Total	...	...	...	...	...	106

The rotation practised on the farm is Cotton followed by Guinea Corn followed by Groundnuts, followed by three years silage and Kyasuwa.

FOOD AND CASH CROPS

Guinea Corn:

- (a) *Farafara*.—A total of 5037 lb. of Farafara was harvested on Field E1-3 (four acres). Yield per acre=1259 lb. Yield in 1955=956 lb.
- (b) *Short Kaura*.—A total of 3024 lb. of Short Kaura was harvested on Field E4 (2.3 acres). Yield per acre=1314 lb.
- Yield/acre 1955=1617 lb.

PASTURE, COVER CROPS, ETC.

Pasture Work:

- (a) *Pasture Improvement*.—Approximately 13 acres of the Tsauni bush area were stumped using hand labour and after ploughing and discing, were planted with seed which had been obtained from Bida.
- (b) *Pasture 5*.—2½ acres of this field were divided into five plots and planted up as follows:—

Plot 1	...	...	...	...	<i>Stylosanthes gracilis</i>
Plot 2	...	...	...	...	<i>Chloris gayana</i>
Plot 3	...	...	...	...	<i>Pueraria phaseoloides</i>
Plot 4	...	...	...	...	<i>Hyparrhenia rufa</i>
Plot 5	...	...	...	...	<i>Panicum maximum</i>

Plot 1 was fenced off to allow dry season grazing only.

- (c) *Pasture Management*.—In the interest of economy in purchase of feeding stuffs for the School cattle, all adult cattle were grazing Pastures 2, 3, 6 and 7 at weekly intervals but it was found that stocking was very much too heavy. A system of management will need to be followed which will give maximum production of grass in the form of hay, bedding and grazing without unduly punishing the pastures.
- (d) *Leys*.—4.2 acres of a mixture of Kyasuwa and *Hyparrhenia rufa* were established on Field C. This field was cut for hay and yielded 5840 lb. hay/acre (Estimated from a sample of 1/20 acre).

Silage.—About 33 tons of medium quality silage was made from a mixture of Maize, Sweet Sorghum and Sunflower harvested from Field B1-4.

HAY MAKING

A total of 60 tons of hay was cut and made on the farm. Hay stacks were established in Field C, Pasture 4, Pasture 5, Pasture 7 and Pasture 8 for feeding to cattle in situ. Some 30 tons were carried to the Stockyard for pen feeding—any surplus will be used as bedding grass—surplus remaining in the field will also be hauled to the Stockyard for use as bedding grass.

Hay Yields.—Pastures 4, 5 and 8 consisting of Gamba comprising a total of 9.5 acres which were not grazed during the year gave an estimated yield of 16.4 tons i.e. 1.73 tons per acre as calculated from 1/20 acre samples.

EXPORT CROPS

Groundnuts (Variety Samaru 38).—A total of 4357 lb. of Groundnuts (unshelled) were harvested from Field A1-3 (4.2 acres). Yield per acre = 1037 lb. Yield in 1955 = 1062 lb.

Cotton (26J).—A total of 1334 lb. of Cotton were harvested from Field F1-3. Yield per acre 205 lb. Yield/acre 1955 = 446 lb.

7.—TRAINING FARM No. 1

This farm is run as a mixed farm with the first year A.A. students doing most of the work.

Cultivations are normally done by bullock implements and a tractor is only used under special circumstances.

Area.—Arable 36 acres divided roughly into half arable crops and half rotation grasses or bush fallow.

							acres
Arable	...	...	...	...	...	...	36
Permanent grazing and fuel reserve	...	...	...	...	...	...	6.4
Compound	...	...	...	...	...	...	0.6
Total	...	...	...	...	...	...	43

Rotation.—As for Main Farm.

Buildings.—Repairs to temporary buildings comprising an implement shed, cattle and goat pens were completed.

FOOD AND CASH CROPS

Guinea Corn.—Two varieties Farafara and Short Kaura were grown on 6 acres. Yields however in both cases were rather disappointing.

Short Kaura.—Total yield 2597 lb. = 1087 lb./acre.

Farafara.—Total yield 3425 lb. Yield per acre 996 lb. Guinea corn yield per acre 1955 = 436 lb.

Cassava.—Two varieties of this crop GC. 997B and Damwari were grown on 1/6 acre in the farm garden as a part of a 4 course rotation with sweet potatoes, maize/cow peas, and miscellaneous vegetables.

The yield for 1955 crops was Damwari 873 lb.=6696 lb./acre GC. 997B. 660 lb.=5280 lb./acre.

The 1956 crop is not yet harvested.

Sweet Potatoes.—Planted on a 1/4 acre plot in the Farm Garden. The variety planted was pink tubered. The foliage was fed to milk cows during October to December. The yield of tubers was disappointing as they were affected by weevils and were fed to the cattle

1956 yield=281 lb.=1124 lb./acre. Yield in 1955=6 tons per acre.

Grasslands.—About 12 acres were left fallow, part 0.7 acre being planted with a mixture of Kyasuwa (*Pennisetum pedicellatum*) and a legume called *Sahemi* (Hausa)—(*Tephrosia bracteolata*) which however became overshadowed by the Kyasuwa.

Of the rest of the 12 acres, 3 acres were in second year Kyasuwa which had reseeded and established well, whilst the other 8 acres were left in bush fallow. All the grass was cut for silage or hay.

Silage.—Silage was made from a mixture of Sweet Sorghum and Kyasuwa in a pit silo. Feeding was commenced towards the end of the March, 1957. The quality seems good.

Hay.—6½ acres of Kyasuwa were cut for hay. 1½ acres were of very good quality but the rest was rather coarse.

Mucuna.—1.4 acres were grown for hay and were cut in the first week of November giving a yield of 2266 lb. per acre.

EXPORT CROPS

Groundnuts.—1.8 acres were grown giving a yield of 439 lb. per acre of kernel compared with 882 lb. per acre in 1955.

Cotton.—4.71 acres of S.26J were grown for the Cotton Breeder, Regional Research Station.

Some water logging occurred and a yield of 520 lb. seed cotton per acre was obtained. This compares with a yield of 214 lb. per acre in 1955.

Kashin Yawo Eradication.—Eradication by use of 2:4:D was attempted during the rains but it was not very successful. This may have been due to the solution being too weak (113.5cc of 2:4:D in three gallons of water) or to over maturity of the weed. The attempt, bearing these two points in mind, is to be repeated this year.

8.—TRAINING FARM No. 2

This farm is run similarly to T.F. 1 but the N.A. Junior Course students do the work.

The rotation is the same as for T.F. 1 with the arable divided up into half arable crop and half rotation grasses and bush fallow.

<i>Areas:</i>							<i>acres</i>
Arable	...	...	...	...	...	...	34
Permanent grazing and fuel reserve	...	...	...	...	...	...	5.5
Compound area	...	...	...	...	...	...	0.5
Total acreage	...	...	...	...	...	...	40.4

Buildings:

Two poultry houses were built and fenced with wire.

The cattle pen roof was re-thatched.

The bases of many of the buildings were strengthened.

The calf pen was heightened 2 feet and re-thatched and the rumbu was re-thatched.

Fencing.—A calf paddock was erected using azara posts and pig wire.

Work on fencing the whole boundary of the farm was started after the area was surveyed.

FOOD AND CASH CROPS

Guinea Corn.—4 acres were planted with a pure stand of Short Kaura and gave a yield of 1391 lb. per acre.

On 2.96 acres Guinea Corn was interplanted with Millet and yielded 587 lb. per acre.

In 1955 the yield per acre of Guinea Corn was 1198 lb.

Millet.—As mentioned above 2.96 acres were interplanted in Guinea Corn. The yield was poor due to bird attack and then an infestation of ergot and the yield per acre (on head) was only 37.1 lb.

Cassava.—The variety grown was Damwari. In 1955 half an acre yield 2460 lb. of tubers per acre. The 1956 crop ($\frac{1}{4}$ acre) is not yet harvested.

Sweet Potatoes.—One quarter acre was grown the variety being Ilorin Native.

Growth was poor, weevil attack being very severe and a yield of 1432 lb./acre was obtained.

Sweet potatoes were not grown in 1955.

Grassland.—About 13 acres were cultivated and planted with Kyasuwa grass. It did very well and 21.2 tons of hay were obtained from the pasture.

Silage.—3.57 tons of grass silage was made in a pit for the cattle. The quality is not as good as on T.F.I. where the silo is lined with concrete, but the stock seem to eat it quite readily. Feeding was commenced on March 18th, 1957.

Hay.—In addition to the 21.2 tons of Kyasuwa hay already mentioned 3 acres of Soya Beans were cut for hay.

TREE CROPS

Citrus Orchard.—This recently planted orchard continued to establish well and some trees commenced to bear. The boundary was fenced and trees mulched and watered during the dry season.

EXPORT CROPS

Groundnuts.—3 acres of S.38 were planted. Growth was good but rosette attack was noticed and monkeys did considerable damage. A yield of 490 lb. per acre in shell was obtained—348 lb. of shelled kernels per acre. Yield in 1955=389 lb. of shelled nuts per acre.

Cotton.—3 acres of variety 26J were grown for the Cotton Breeder. A yield of 271 lb. seed cotton per acre was obtained.

Yield in 1955 was 179 lb. per acre.

Water Supply.—A semi-rotary pump and piping were installed at the well.

Fuel Reserve.—300 Mahogany seedlings were planted in the fuel reserve area. The take was poor and much supplying was necessary.

9.—SCHOOL TRIALS

EXPT. N AND P ON RICE HI (56)

Object.—To determine the effect of Superphosphate and Sulphate of Ammonia singly and in combination on irrigated rice.

Layout.—2x2 Fractional Randomised block: seven blocks each of four plots.

Treatments.—

<i>Sulphate of Ammonia</i>							
NIL	...	...	...	...	...	...	No
1 cwt per acre	...	...	...	...	...	...	N,
<i>Superphosphate</i>							
NIL	...	...	...	...	...	...	Po
1 cwt per acre	...	...	...	...	...	...	P1

Results.—Superphosphate produced the only significant response i.e. 1 cwt is significantly better than nil.

This trial was supervised by the Agronomist, Regional Research Station. The negative result as far as the application of Sulphate of Ammonia was concerned may be due to the fact that the site used was the new irrigation section which had only just been brought into cultivation. The experiment is to be repeated.

10.—NURSERY

During the year the nursery blocks were re-organised and some improvements were made to the potting shed.

The area for growing vegetables and raising citrus and mango seedlings was divided into eight blocks with 3 ft. path between them. Each block is 126 ft. long and 37 ft. wide. Three of the blocks are to be permanently under citrus and mangos and the rest under vegetables.

The mango and citrus blocks were each divided into three equal parts to be cropped as follows:—

1st year plot for transplanting young seedlings.

2nd year plot for second year seedlings to be budded at the end of the 2nd year.

3rd year plot for budded seedlings for transplanting at the end of the third year.

The remaining five blocks were allotted to Root and Tuberous crops, Legumes, Leaf and Stem Vegetables, Fruit, Vegetables and Miscellaneous crops. This cropping will permit the use of crop rotations and is of educational value to students.

Improvements in the potting shed included the construction of ten bays with latticed tops and a water trough of internal dimensions 14 ft. long and $2\frac{1}{2}$ ft. wide. These improvements provided a suitable place for storing manures, fertilisers, seed pots and trays. Germination tests and raising manures, fertilisers, seed pots and trays could also be carried out with ease. Seed pots in the water trough can be kept moist by capillary water.

Budding of Citrus and Mango.—During the season, students carried out budding practice under the supervision of the School Nursery Demonstrator. The following results were obtained:—

								No. of Seedlings Budded	No. of Successful Budding	Percentage take
Mango	...	...	...	...	...	...	...	126	10	7.93
Citrus	...	...	...	...	...	...	...	104	42	40.38

The low budding percentage on citrus was due to lack of experience on the part of the students. The result of Mango budding is generally very unsatisfactory at Samaru.

At the end of the year, there were 1,000 mango seedlings and 307 citrus seedlings for budding during the coming season.

Cocoa Seedlings.—Thirteen out of the thirty-five cocoa seedlings raised from soil blocks and later transplanted into pots are still alive. The seeds were obtained from a cocoa pod received from Ibadan.

11.—VEGETABLES

The vegetables grown in the School Nursery were classified and grown under five headings:—e.g.

- (1) Root and tuberous crops, e.g. Potatoes, Yams, etc.
- (2) Edible legumes, e.g. Beans, Pigeon Peas, Soya beans.
- (3) Leaf and Stem vegetables, e.g. Cabbage lettuce, etc.
- (4) Fruit Vegetables, e.g. Tomatoes, Pumpkin, etc.
- (5) Miscellaneous, e.g. Sugar Cane, Maize, Mint, etc.

The object of these vegetable plots is to introduce to the students during their practical lessons as many useful local and introduced crops as is practical.

The sum of £13-5s-4d was realised from the sale of vegetables from the Nursery during the year.

12.—IRRIGATION

In order that the students may be familiar with the technique of growing rice under the irrigation system, an experiment was carried out in the School irrigation area. This is reported on under school trials.

Growing of vegetables under irrigation continued throughout the dry season.

13.—HOSTEL AREA

During the year hedges were planted on the Hostel site to try and improve the appearance of the area. Some of the hedges have taken quite well but a lot of replanting will be required in other parts this next year.

14.—FARM GARDEN

The Farm Garden was again used for the growing of common and less common crops of Nigeria for demonstration purposes.

There was also a small Botanical Garden with plots planted according to Natural Orders.

15.—LIVESTOCK

ANNUAL CATTLE RETURN

	<i>Bulls</i>	<i>Cows</i>	<i>Young Bulls</i>	<i>Heifers</i>	<i>Bull Calves</i>	<i>Heifer Calves</i>	<i>Total</i>
Stock on hand 1-4-56 ...	29	17	4	10	4	4	68
Births 1-4-56—31-3-57 ...	—	—	—	—	9	8	17
Transfers-in 1-4-56—31-3-57 ...	—	—	5	4	—	—	9
Total ...	29	17	9	14	13	12	94
Deaths 1-4-56—31-3-57 ...	—	—	1	—	—	—	1
Transfers-out 1-4-56—31-3-57	7	—	1	—	5	4	17
Stock on hand 31-3-57 ...	22	17	7	14	8	8	76

Analysis:

Death.—due to Red water (Piroplasmosis) Young bull No. 82 died from the above disease on 16-3-57.

Transfers-out:

(a) Culls due to old age—six work bulls—No. 11, 236, 23, 4, 5 and 7 were considered unsuitable and sold out at market values.

(b) *Accidents:*

(i) Young bull No. 93 was knocked down by a train on 17-7-56. Its carcase was sold to local butchers.

(ii) Work bull No. 196 fractured its stifle bone on 5-1-57 and was slaughtered immediately on the advice of the Veterinary surgeon.

Milk Production:

	lbs
Total Weight of milk produced 1-4-56-31-3-57	22314.00
Total Weight of milk bucket-fed to calves 1-4-56-31-3-57	766.00
Total Weight of milk hand-fed to piglets 1-4-56-31-3-57	1428.25
Total Weight of milk supplied to students Hostel 1-4-56-31-3-57	9680.00
Total Weight of milk surplus to requirements sold 1-4-56-31-3-57	1622.25
Total Weight of milk estimated suckled by calves 1-4-56-31-3-57	8817.5

*Diseases**(i) Routine Vet. Treatments.*

<i>Date</i>	<i>Class of Cattle</i>	<i>Inoculation/Preventive and Curative treatment</i>	<i>Diseases</i>
12-4-56	All Stock	H.S.V. and B.Q.V.	Protection against H. Seplicaemia and Black Quarter
28-5-56	„	P.P.V.	Protection against Pleuro-pneumonia
27-10-56	Yearlings	D.G.V.	Protection against Rinderpest
24-11-56	Weaners	L.G.V.	Protection against Rinderpest
12-1-57	All Stock	B.Q.V. and P.P.V.	Repeated protection
26-1-57	„	H.S.V. and A.S.V.	For curing Trypanosomiasis
4-2-57	Heifers	Ethidium Bromide	For curing Trypanosomiasis
9-2-57	Cows	Ethidium Bromide	For curing Trypanosomiasis
13-3-57	Bulls and Heifers ...	Ethidium Bromide	For curing Trypanosomiasis
13-3-57	Young bull	Babesan	For curing Red water

(ii) *General Health.*—With the co-operation of the Veterinary Department all were maintained in good health throughout the year.

GOATS

	<i>Billy Goat</i>	<i>Nanny Goat</i>	<i>Doe</i>	<i>Billy Kid</i>	<i>Nanny Kid</i>	<i>Total</i>
On hand 1-4-56	2	5	—	2	3	12
Add births 1-4-56-31-3-57	—	—	—	5	8	—
Add transfers in 1-4-56-31-3-57	—	3	6	—	—	—
Add purchases in 1-4-56-31-3-57	—	3	6	—	—	—
Total	2	8	3	7	5	—
Subtract deaths 1-4-56-31-3-57	—	—	—	2	2	—
Subtract transfers out 1-4-56-31-3-57	—	—	—	—	—	—
Subtract sales	—	2	—	2	—	—
	2	6	3	3	3	17

Notes:

1. (a) Thirteen kids were born during the year.
- (b) Four kids (two Nanny kids and two Billy kids) died during the year. Causes not known.
- (c) Four goats (two Nanny goats and two Billy kids) were sold.
2. *Health*.—Satisfactory.

16.—POULTRY
ANNUAL FLOCK RETURN

<i>Type of Poultry</i>									<i>Total Stock on 1-4-56</i>	<i>Total Stock on 31-3-57</i>
Fowls	...	...	...	...	...	...	...	...	178	62(a)
Ducks	...	...	...	...	...	...	...	...	19	45(b)

Notes:

1. (a) 53 chicks were hatched
49 birds were received from Riyom
20 birds were received from Vom
130 birds were sold for unsuitability
108 birds died due to various causes.
- (b) 30 Ducks were received from Riyom
2 Ducks were sold (Drakes)
2 Ducks died (1 due to F.P. and 1 unknown cause)

2. The Veterinary Officer Zaria advised the disposal of the entire flock of fowls due to incidence of tapeworms, roundworms and tuberculosis. After the disposal no fowls were kept for about three months and the badly waterlogged old site was abandoned. When new birds arrived from Riyom and Vom, after the three months period of "No Fowls", they were moved to the new site which is better drained.

EGG PRODUCTION

<i>Quarter</i>									<i>Fowl</i>	<i>Ducks</i>	<i>Total</i>
April-June 1956	...	...	...	...	...	...	...	...	1,015	—	1,015
July-September 1956	...	...	...	...	...	...	...	...	450	148	598
October-December 1956	...	...	...	...	...	...	...	...	341	173	514
January-March 1957	...	...	...	...	...	...	...	...	181	137	318
									1,987	458	2,445

Revenue.—The sum of £39-8s-7d was collected from the sale of birds and eggs during the year.

ARTIFICIAL INCUBATION

Hatching figures are summarised below:—

<i>No. of Eggs Set</i>	<i>Infertile eggs</i>	<i>Dead in Shell</i>	<i>Hatched</i>	<i>Hatching per cent</i>	<i>Fertility per cent</i>
295	168	74	53	18	43

Vet. Practices.—Routine dosing of all birds with .05 grams of sulphamezathine per bird per day was carried out regularly during the year.

On 12-7-56 all flocks were vaccinated against Newcastle Disease

„ 3-8-56 „ „ „ „ „ Fowl Fox

„ 21-8-56 „ „ „ „ „ Fowl cholera and Fowl Typhoid

Nefco was fed at regular intervals against coccidiosis and Tenoban. Tablets for tape worms were also given.

17.—PIGS

ANNUAL PIG RETURN

	<i>Stud Boar</i>	<i>Breeding Sow</i>	<i>Gilt</i>	<i>Young Boar</i>	<i>Fatteners</i>	<i>Piglet</i>	<i>Total</i>
On hand 1-4-56 ...	2	5	—	—	31	9	47
Add births 1-4-56-31-3-57	—	—	—	—	—	82(a)	
Add transfers in 1-4-56-31-3-57 ...	—	1	2	—	57	—	
Add purchases in 1-4-56-31-3-57 ...	—	—	1	1	—	—	
Total ...	2	6	2	1	86	34	
Subtract deaths 1-4-56-31-3-57 ...	—	—	—	—	—	29(b)	
Subtract transfers out 1-4-56-31-3-57 ...	—	—	—	—	—	—	—
Subtract sales ...	1	1	—	—	63(c)	—	
Total (i.e. on hand 31-3-57)	1	5	2	1	23	5	37

Notes:

(a) Eighty-two piglets were farrowed in eight litters during the year.

(b) Of the twenty-nine piglets shown under this column sixteen were crushed by dams, four were born dead and eight died due to lack of milk and weakness at birth and one culled for unthriftiness.

(c) Sixty-three pigs (one barren L.B. sow, one old L.B. Boar and sixty-one fatteners) were sold during the year.

Revenue.—The sum of £702-10s-4d was realised from the sale of sixty-three pigs during the year. Of this number sixty-two were slaughtered and sold at Station prices and one was sold to A.O., Zonkwa as a breeding gilt.

Health.—General health of all animals was good throughout. Sow No. 22 suffered from pre parturition milk fever. An injection of 100 c.c. calcium barogluconate proved an effective treatment. About four cases of Agalactia occurred during the year. Intravenous injections of Pituitary extract were not effective. Both the Biochemist at the Regional Research Station and the Veterinary Officer Zaria are investigating the condition for us. Meantime the following instructions are followed:—

- (a) Keep sows on roughage after weaning to six weeks before farrowing.
- (b) Allow sows adequate exercise after farrowing.
- (c) Feed six pints milk plus two heaped tablespoonful icing sugar per pint milk per sow per day from six days before farrowing.
- (d) Feed iron.
- (e) Watch litters and start them off on cow's milk if necessary.

Vet. Practices.—Routine treatment with piperazine against worms was carried out regularly during the year. The smearing of palm oil was effective in controlling minor lice infestation.

General.—(1) One pen was converted into a farrowing pen and fitted with—

- (a) Farrowing rails;
- (b) Baffle walls to ensure quietness
- (c) Small exercise and sunshine runs.

A creep feed and exercise and sunshine yard for suckling sows was constructed.

A small area was planted up with Elephant grass and irrigation channels preferred to produce green food for all stock. This area was fenced in.

18.—SOIL CONSERVATION

The following First Aid measures were carried out on the Soil Conservation works on Fields F and G and Paddocks 6, 7 and 8:—

- (a) Planting up of Kiri Kiri in all main water courses.
- (b) Planting up of Gamba stools along retaining walls of water courses.
- (c) Insertion of laterite stone bars in water courses showing signs of wash.
- (d) Removal of some trees causing trouble in water courses.

The roadside drain around the poultry site was deepened to allow road water to drain away from poultry site and not to cause water logging as in the past.

APPENDIX I

19.—ENROLMENT: 1953-1957

			<i>No. on Course</i>	<i>Successfully Completed Course</i>	<i>Failed</i>	<i>Left</i>	<i>No. at End of Course</i>
1.	1953 A.As.	... ..	12	12	—	—	—
2.	1954 A.As.	... ..	26	20	—	6	—
3.	1955 A.As.	... ..	21	16	2	3	—
4.	1955 A.A.Os.	... ..	12	7	1	4	—
5.	1955 N.A.J.C.	... ..	30	30	—	—	—
6.	1956 A.As.	... ..	17	—	2	5	10
7.	1956 N.A.J.C.	... ..	31	28	1	2	—
8.	1957 A.A.Ss.	... ..	9	—	—	—	9
9.	1957 A.As.	... ..	32	—	—	4	28
10.	1957 N.A.J.C.	... ..	30	—	—	—	30
			220	113	6	24	77

APPENDIX II

20.—SCHOOL MAIN FARM AND LIVESTOCK SECTIONS AS AT 31/3/57

	<i>Total Acreage</i>	<i>Acreages</i>		<i>Livestock</i>	<i>Object</i>
		<i>Arable Areas</i>	<i>Non Arable Areas</i>		
School Main Farm and Livestock Sections	114.03	Grain 6.3 acres Silage 6.3 " Cotton 6.5 " Groundnuts 4.2 " Orchard Nil	Roads Compound Building Areas Yards Erosion Control 3 acres	<i>Numbers</i> Cattle 76 Sheep Nil Goats 17 Pigs 37	Training Students
		Pastures 49.3 " Leys 8.5 " Unimproved Pastures 18.13 "	Fire Wood Belt Tree Belt Unsuitable as Arable 4.55	Chickens 62 Ducks 45 Gees Nil	

APPENDIX III

21.—CROP DETAILS MAIN FARM

Crop	Variety	Ridge width	Spacing Between Stands	Seed Rate per Acre	Tons F.Y.M. per Acre	lb Super phosphate per Acre	lb Sulphate of Ammonia per Acre	Seed Treatment	Field	Total Yield (lb)	Yield per Acre	Yield per Acre 1954	Yield per Acre 1955
Cotton ...	26J	30"	15"	48lb	2	—	56	Acid treated	F1-3	1334.5	205.5	623	446
Guinea Corn ...	Farafara	30"	2'	10lb	3	56	56	Dusted with Cop-per Car-bonate	E1-3	5037 lb dry grains	1259 lb dry grains	1,005	956
Guinea Corn ...	Short Kaura	30"	2'	10lb	3	56	56	Dusted with Cop-per Car-bonate	E4	3024 dry grains	1314 lb dry grains	1,408	1,617
Groundnuts ...	S. 38	30"	9"	48lb	—	56	—	—	A1-3	4,367	1037.38	311	1,062

Part IIIA—Agricultural Research Scheme

1. The detailed Research Report which follows should be consulted for details of the work outlined briefly below.

2. *Staff.*—The Senior staff position improved further, new arrivals being two plant breeders (one a seconded officer of the Empire Cotton Growing Corporation), one Ecologist, one Agricultural Chemist, one Agricultural Officer (Grassland) and three officers of Superintendent grade, (a Cartographer, a Field Soil Surveyor and a Horticultural Superintendent). One Agricultural Officer was transferred from Grassland work to field duties, and one Entomologist (E.C.G.C.) resigned to take up a post at the Imperial College of Tropical Agriculture.

The Junior staff position improved slightly but is still not satisfactory: as seen in the following table it is little better than in 1954, though an improvement on last year.

	1-4-54	1-4-55	1-6-56	1-4-57
Assistant Agricultural Officers	7	3	2	10
Senior Agricultural Assistants and Agricultural Assistants	36	31	27	26
Field Overseers	25	21	27	38
Clerical Staff	14	12	10	13

3. Buildings continue to lag behind staff increases, and the housing of Senior Staff remains precarious, while their working accommodation becomes progressively more cramped.

4. *Visitors.*—Among many others, the following distinguished visitors were received at Samaru during the year: Mr K. P. Maddocks. Acting Governor of the Northern Region, Sir Ralph Grey, Chief Secretary to the Government of the Federation, the Premier of the Northern Region, the Honourable the Sardauna of Sokoto, the Minister of Natural Resources, the Honourable Isa Kaita, Sir William Slater, Agricultural Research Council and Mr D. Rhind, Research Adviser to the Colonial Office.

The Season was disappointing. The total rainfall of 36.5 inches was well below average; the planting rains were late and interrupted by periods of drought; and the rains finished early, for although 3.55 inches were recorded for October, they all fell in the first eight days of the month.

6. The Agronomy Section, apart from its responsibility for analysis and summarising of all trials, and its direct responsibility for trials of an agronomic nature, took over in the present year the series of fertiliser trials in the provinces previously controlled by the Chemistry Section. A further considerable volume of such trials is reported this year, and the number of results is now such that useful response curves for the major crops, at least

for some parts of the country, will soon be feasible. These will be of very great value to extension workers, and the pursuit of these trials must at present be regarded as the most important of the agronomic studies.

7. The Botany Section report shows considerable progress in the sorting out on a regional basis of the interaction between varietal types and ecological areas in both groundnuts and sorghum. To those unfamiliar with the region, this may at present appear to be merely a report of a mass of separate variety trials, but (as with fertiliser trials) the stage has almost been reached when a major rationalisation can be made.

More extensive use has been made of the "planting sequence" trial (figures 1 and 2 of last year's report), and it has again been found that, in spite of its inherent potential weakness, this approach to "planting date" problems gives a very much better picture of the effect of planting date on performance than do planting date trials with a limited number of rather widely spaced dates, and moreover is likely to lead to conclusive results in a shorter period of years.

In pathological studies, progress has been made in the study of rosette of groundnuts, but there is a very serious gap here on the insect side of the problem, which cannot at present be filled. A start was made on the effect of *Cercospora* leaf spot on groundnut yields, and work continued on the main cereal diseases.

8. *Cotton Work*.—The breeding programme has continued on established lines, and further data are adduced on the continuing superiority of Samaru 26J strain over its predecessor Samaru 26C. The new strain has now completed the 4,000 acre stage in the seed multiplication scheme.

Preliminary work on soil-water-plant relations on Samaru soils, carried out by a member of the cotton breeding staff, show very interesting indications.

Further data on the biology and control of pests of cotton were recorded, and indications were obtained that a combination of timely sowing, fertiliser and insecticide (but no one of the three alone) might produce considerable cotton yields in the Riverain Area, where yields are normally extremely low.

The posting by the Empire Cotton Growing Corporation of a pathologist to Samaru enabled a start to be made on more intensive studies of the Bacterial Blight problem than has previously been possible.

9. The Chemistry Section continued to be understaffed on all but the biochemical side, and the main interest in the report of this section lies in the Biochemist's studies of carotene and vitamin A in cattle, and preliminary digestibility trials with sheep.

10. The Grassland Section's transfer to Shika was completed and preliminary steps taken towards the integration of this and the cattle breeding and husbandry work at Shika into a single section. Reports are presented on a number of establishment, productivity and seed production trials, and on

an interesting trial in various methods of grassland management from unmanaged "bush" through various combinations of burning and grazing to controlled grazing, mowing and conservation.

11. The Soil Survey Section in its second year as a separate section reports a considerable programme of ad hoc surveys: each of these is urgently required for a specific project, and a considerable back-log of such surveys has to be worked off before soil survey on a more systematic planned basis can be contemplated.

Part IIIB—Research and Specialist Services

I—General Introduction

By

E. J. Butler

During the year under review the Senior Staff position further improved. New arrivals were: in the Botany Section two Plant Breeders (one a seconded officer of the Empire Cotton Growing Corporation) and a Specialist Assistant (Horticulture); in the Soil Survey Section two Specialist Assistants, one a Cartographer and one a Soil Surveyor; in the Grassland Section an Ecologist and an Agricultural Officer; a Chemist also arrived and a Termite Research Officer of the Overseas Civil Service is temporarily posted here. One Agricultural Officer was transferred from the Grassland Section to extension work and a cotton Entomologist resigned to take up a post at the Imperial College of Tropical Agriculture.

New building still lags behind the increase of staff and the housing situation is still precarious. Office and laboratory accommodation similarly present an increasingly difficult problem.

In contrast with the Senior Staff the Junior Staff position is still very unsatisfactory and there is no reason to hope for any improvement for some time to come. The following figures show the numbers of established Junior Staff in various grades at the beginning of the last four financial years.

	1-4-54	1-4-55	1-4-56	1-4-57
Assistant Agricultural Officers	7	3	2	10
Senior Agricultural Assistants and Agricultural Assistants	36	31	27	26
Field Overseers	25	21	27	38
Clerical Staff	14	12	10	13
	82	67	66	87

VISITORS

Samaru was honoured by visits from Mr K. P. Maddocks, C. M. G., Acting Governor, Sir Ralph Grey, Chief Secretary to the Government and by the Honourable the Sardauna of Sokoto, Premier of the Northern Region.

Visits were also paid by the Honourable Alhaji Isa Kaita, Minister of Natural Resources and the Honourable Alhaji Abba Habib, Minister for Northern Cameroons Affairs. Apart from members of the Department, the following (in chronological order) were among the other visitors to the station during the year.

Sir William Slator, Agricultural Research Council, London.
Dr S. G. Wilson, Director of Veterinary Services, Kaduna.
Mr E. J. Oliver, United Kingdom Trade Commissioner, Lagos.
Dr Ford B. Milam, U.S.A. Agricultural Attache, Monrovia.
Mr J. S. Jones, Acting Director of Agriculture, Sierra Leone.
Mr H. B. Jordon, W.A. Rice Research Station, Sierra Leone.
Mr A. Pickles, W.A.I.T.S., Accra.
Mr J. C. F. Hopkins, Commonwealth Mycological Institute.
Mr A. Long, Government College, Ibadan.
Mr R. A. Craufurd, W.A. Rice Research Station, Sierra Leone.
Mr A. V. Gibberd, Cocoa and Cola Survey.
Mr A. C. Barnes, Tate and Lyle.
Mr Melvin J. Fox, Ford Foundation, New York.
Mr N. M. O. Brown, Ford Foundation, New York.
Mr J. B. Howard, Ford Foundation, New York.
Mr D. F. Ruston, E.C.G.C., London.
Mr M. H. Cathala, Tomas, Senegal.
Col., the Rt. Honourable the Earl of Derby, M.C.
Mr D. Rhind, Colonial Office, London.
Mr M. E. Mayne, N.I.A.E., Silsoe, England.
Mr R. S. Marshall, Veterinary Section, Colonial Office, London.

METEOROLOGICAL REPORT

The main meteorological data recorded at Samaru are presented in Appendix I. The season was disappointing. The rainfall of 36.5 inches was well below average. The planting rains were late and interrupted by periods of drought; they also finished early for although 3.55 inches are recorded as falling in October the whole of this fell during the first eight days of the month. The unsatisfactory rainfall was not peculiar to Samaru but was general to most of the Region.

SCOPE OF THE REPORT

The report covers the investigational work of the specialist sections, whose headquarters are at Samaru and Shika, with substations started in the present year at Kano, Katsina and Mokwa. The trials reported include, apart from those at the Research Headquarters and Substations, the trials and observations carried out under the supervision of the field staff at the Government and Native Authority farms and on the land of individual farmers in all the twelve provinces of the Region.

Throughout the experimental reports significant differences are indicated by:

***	...	...	...	...	...	...	...	Significant at $P = 0.001$
**	...	...	...	...	...	...	...	Significant at $P = 0.01$
*	...	...	...	...	...	...	...	Significant at $P = 0.05$

N.S. Not Significant.

N.A. Data not statistically analysed.

Local names of crops are used, and the botanical names of these crops are listed in Appendix III.

II—Agronomy Section

By

K. A. Watson

A.—GENERAL

The work of the Agronomy Section increased considerably during the year under review. Responsibility for fertiliser experiments was transferred from the Chemistry Section to the Agronomist thus increasing the number of experiments directly controlled by the latter to over 140. Increase in specialist staff in other sections resulted in more experiments being designed and analysed by the Agronomy staff. Staffing during most of the year was difficult on both the Junior and Senior sides but improved on the Senior side towards the end of 1956 with the return of the Specialist Superintendent from the United Kingdom after completing a year's course in statistics at Aberdeen.

SAMARU

The rains were exceptionally late and erratic at the beginning of the season, which resulted in some trials having to be replanted after failure of the first sowings. From late June onwards however, the rains were average and guineacorn and groundnuts did well although cotton yields were rather below average.

TABLE 1. AVERAGE YIELD IN LB. PER ACRE OF MAIN CROPS, SAMARU

Season					Seed Cotton 26C	Guineacorn grain		Groundnuts Kernels
						Light Mori	Short Kaura	S 38
1952	...	...	...	...	301	1,013	1,173	729
1953	...	...	...	...	430	603	1,144	754
1954	...	...	...	...	473	861	944	606
1955	...	...	...	...	402	926	946	510
1956	...	...	...	...	364	1,000	1,107	756

Note:

(a) Cotton Variety 26J was used in place of 26C for the first time in 1956.

(b) Yields are taken from relatively small nonexperimental areas.

OUTSTATIONS

Trials at outstations were adversely affected by the erratic early rains which delayed planting in many areas, resulting in below average yields. The normal dry spell in much of the Middle Belt during July—August caused crop failures on some experiments. In some northern areas the rains stopped earlier than usual.

CATTLE

It was decided by the Director that all work with Ndama cattle should be transferred to Middle Belt stations. As a result arrangements were made to break up the Agronomist's cattle herd at Samaru. Only the nucleus of a White Fulani herd is being retained for work purposes and production of farm yard manure.

A.—EXPERIMENTS REPORT

GROUNDNUTS

Fertiliser Trials(1) *Nitrogen and Phosphate Trials on Groundnuts.*

(a) *Plateau Province—Langtang.*—This trial was repeated in 1956; the results are given in Table 2.

TABLE 2. NITROGEN AND PHOSPHATE ON GROUNDNUTS, LANGTANG
Yields in lb. Kernels per acre

<i>Treatment</i>	1956	1955
<i>Sulphate of Ammonia:</i>	***	**
Nil	422	1,517
$\frac{1}{2}$ cwt per acre	501	1,811
1 cwt per acre	567	1,715
<i>Superphosphate</i>	***	**
Nil	370	1,491
$\frac{1}{2}$ cwt per acre	566	1,766
1 cwt per acre	555	1,787
S.E.	± 21	± 68

<i>Interaction NxP*</i>										<i>Sulphate of Ammonia</i>		
<i>Superphosphate</i>										<i>Nil</i>	$\frac{1}{2}$ cwt	1 cwt
Nil	...	...	...	...	...	...	...	...	...	233	446	430
$\frac{1}{2}$ cwt	...	...	...	...	...	...	...	...	...	511	516	670
1 cwt	...	...	...	...	...	...	...	...	...	522	541	601
S.E.										± 37		

Responses to the two fertilisers are marked and the interaction between them is positive. The pattern is similar to that obtained in 1955 although yields were very much higher in that year.

A subsidiary trial was carried out at Langtang to determine whether the response to sulphate of ammonia is due to the nitrogen content or the

sulphate content. The trial was late planted and suffered from drought and yields were too low to enable any conclusions to be drawn. However observations made during the growing season showed a marked response in vegetative colour to sodium sulphate; no equivalent response was seen with either triple superphosphate or ammonium chloride.

Jermai.—This trial was repeated for the second time. No significant results were obtained but there was a very marked trend in favour of superphosphate. The C.V., was excessive (36 per cent). The results for 1954 and 1956 are given in Table 3. The trial was not carried out in 1955.

TABLE 3.—NITROGEN AND PHOSPHATES ON GROUNDNUTS, JERMAI
Yields in lb. Kernels per acre

<i>Treatment</i>	1956	1954
<i>Sulphate of Ammonia:</i>	N.S.	*
Nil	423	328
$\frac{1}{2}$ cwt per acre	424	425
1 cwt per acre	475	458
<i>Superphosphate:</i>	N.S.	N.S.
Nil	385	346
$\frac{1}{2}$ cwt per acre	465	411
1 cwt per acre	472	458
S.E.	± 46	± 34

The NxP interaction was not significant in either year. The significant response to sulphate of ammonia obtained in 1954 was not repeated in 1956. Yields were rather low in both years.

(b) *Adamawa Province*.—Trials were carried out at Jalingo and Jada; both suffered from heavy rosette attack and yields were very low. The results of the two trials are given in Table 4.

TABLE 4.—N AND P ON GROUNDNUTS, JALINGO AND JADA
Yields in lb. Kernels per acre

<i>Treatment</i>	<i>Jalingo</i>	<i>Jada</i>
	<i>Kernels</i>	<i>Kernels</i>
<i>Sulphate of Ammonia:</i>	***	N.S.
Nil	148	141
$\frac{1}{2}$ cwt per acre	223	147
<i>Superphosphate:</i>	N.S.	*
Nil	177	135
$\frac{1}{2}$ cwt per acre	194	153
S.E.	± 9	± 5

Interaction NxP									Jalingo		Jada					
									Superphosphate				Sulphate of Ammonia			
													Nil	$\frac{1}{2}$ cwt	Nil	$\frac{1}{2}$ cwt
Nil	...	...	...	...	...	...	...	...	125	229	140	130				
$\frac{1}{2}$ cwt	...	...	...	...	...	...	...	...	171	218	142	165				

Examination of rosette counts taken on the Jalingo trial showed significantly less rosette on the sulphate of ammonia plots. The increase in yield due to sulphate of ammonia in this case is probably due to increased vegetative growth reducing rosette incidence rather than to a direct nitrogen effect on yield.

(c) *Zaria Province*.—One trial was carried out at Zonkwa on early groundnuts. The usual practice in this area is to plant groundnuts very early and to follow with transplanted dauro after the groundnuts have been harvested. This is the second year of this trial. Results for both years are given in Table 5.

TABLE 5.—N AND P ON EARLY GROUNDNUTS FOLLOWED BY DAURO, ZONKWA

Yields in lb. Kernels and Threshed Grain per acre

<i>Treatment</i>								1956		1955	
								<i>G'nut Kernels</i>	<i>Dauro Grain</i>	<i>G'nut Kernels</i>	<i>Dauro Grain</i>
<i>Sulphate of Ammonia:</i>								N.S.	N.S.	*	N.S.
<i>Nil</i>	...	...	...	...	...	...	...	222	269	335	716
$\frac{1}{2}$ cwt per acre	...	...	...	...	...	...	...	219	271	396	741
1 cwt per acre	...	...	...	...	...	...	...	224	289	386	736
<i>Superphosphate:</i>								***	*	***	**
<i>Nil</i>	...	...	...	...	...	...	...	175	228	322	662
$\frac{1}{2}$ cwt per acre	...	...	...	...	...	...	...	240	296	376	729
1 cwt per acre	...	...	...	...	...	...	...	250	305	420	802
S.E.	...	...	...	...	...	...	...	±11	±18	±17	±28

Yields in 1956 were much lower due to drought. The significant effect of superphosphate on groundnut yields was repeated as was the residual response on the transplanted dauro crop. This residual effect will have to be considered when working out the economics of fertiliser application.

The significant response of groundnuts to sulphate of ammonia in 1955 was not repeated this year. In neither year was the NxP interaction significant on either crop.

(d) *Sokoto Province*.—An observation trial has been carried out at Kasarawa for the last two years. The results are given in Table 6.

TABLE 6.—N AND P ON GROUNDNUTS, KASARAWA
Yields in lb. Kernels per acre

<i>Superphosphate</i>	1956 <i>Sulphate of Ammonia</i>			1955 <i>Sulphate of Ammonia</i>		
	<i>Nil</i>	$\frac{1}{2}$ cwt per acre	1 cwt per acre	<i>Nil</i>	$\frac{3}{4}$ cwt per acre	1 cwt per acre
Nil	376	592	471	699	484	887
1 cwt per acre	538	551	618	807	914	807
2 cwt per acre	518	566	517	860	1,049	726

Yields were very much down this year and the response to fertilisers is not as marked but there is still an indication of a positive interaction between N and P. It is proposed to carry out a replicated trial as soon as land is available.

(e) *General*.—The response obtained with sulphate of ammonia in some of these N and P trials tends to re-open the whole question of fertilisers on groundnuts. Work in the past has tended to concentrate on superphosphate, forms of phosphate and placement. Whether the response is to nitrogen or the sulphate radicle is not known. Previous work has shown that groundnuts in some parts of Northern Nigeria do respond to sulphur. Workers in other parts of the world have shown that groundnuts respond to nitrogen. Most of the N and P trials on groundnuts so far carried out have been in the Middle Belt and not in the main groundnut growing areas. It is proposed to initiate N and P trials in these areas as soon as staff and facilities are available.

(2) *Phosphate Trials on Groundnuts:*

(a) *Bauchi Province*.—Four trials were carried out testing the effect of phosphate on groundnuts at various levels. The results are presented in Table 7.

TABLE 7.—SUPERPHOSPHATE ON GROUNDNUTS, BAUCHI PROVINCE
Yields in lb. Kernels per acre

<i>Treatment</i>	<i>Azare</i>	<i>Gadau</i>	<i>Chinade</i>	<i>Dambam</i>
<i>Superphosphate:</i>	***	***	**	***
Nil	643	442	550	780
$\frac{1}{2}$ cwt per acre	872	497	560	872
1 cwt per acre	968	578	630	1,008
$1\frac{1}{2}$ cwt per acre	1,064	653	720	1,072
S.E.	±17	±23	±27	±24

Only at Azare and at Dambam can superphosphate be said to have produced economic returns in yield. At Gadau and Chinade the response to the recommended dressing of $\frac{1}{2}$ cwt per acre is not significant.

(3) *Residual effects of Fertilisers and Manures on Groundnuts:*

(a) *Katsina Province, Daura*.—In 1955 a trial was carried out testing times of application of superphosphate to millet. The residual effect of these

applications was measured using groundnuts in 1956; there was a significant increase in yield from the residual phosphate. The results are given in Table 8.

TABLE 8.—RESIDUAL EFFECT OF SUPERPHOSPHATE ON GROUNDNUTS, DAURA
Yields in lb. per acre

<i>Treatment</i>	1956 (Residual)	1955
<i>Time of Application</i>	<i>Groundnut Kernels</i>	<i>Millet Grain</i>
<i>Superphosphate:</i>	*	**
Nil	383	269
60 lb/ac. at planting	563	330
60 lb/ac. at 2-leaf stage	480	376
60 lb/ac. at 4-leaf stage	516	321
S.E.	±42	±20

Superphosphate applied in the previous year again produced a significant increase in yield.

(b) *Adamawa Province—Yola.*—In 1955 a factorial N and P trial was carried out on guineacorn. The residual effects of the fertilisers were tested on groundnuts in 1956. Groundnut yields were very low due to poor rains and heavy rosette attack and no significant results were obtained. The yields are given in Table 9.

TABLE 9.—RESIDUAL EFFECTS OF SULPHATE OF AMMONIA AND
SUPERPHOSPHATE ON GROUNDNUTS, YOLA
Yields in lb. per acre Kernels and Threshed Grain

<i>Treatment</i>	1956 (Residual) <i>G'nut kernels</i>	1955 <i>G'corn Grain</i>
<i>Sulphate of Ammonia:</i>	N.S.	**
Nil	137	972
1 cwt per acre	139	1,215
2 cwt per acre	186	1,205
S.E.	±37	±51
<i>Superphosphate:</i>	N.S.	***
Nil	131	865
1 cwt per cre	190	1,203
2 cwt per acre	139	1,272
3 cwt per acre	156	1,193
S.E.	±43	±59

(c) *Niger Province—Bida.*—A time of application of N and P trial on guineacorn was carried out in 1955. The residual effects of the fertilisers were tested on groundnuts in 1956. The crop was almost a complete failure due to rosette and no analysis of the results was carried out. Yields of shelled nuts varied from 48—185 lb per acre; there was no indication of any residual effect from the fertilisers. Shelling percentages were abnormally low varying from 17–27 per cent; this is characteristic of groundnuts on Bida Farm.

The Correlation coefficient between weight of haulms and rosette incidence was calculated as $r = -0.281^*$ ($P = .05$).

Badeggi.—Yields of all crops have been extremely low on the old Badeggi tractor unit farm. An observation trial has been carried out since 1954 to investigate the effects of various combinations of fertilisers and farm yard manure on crop yields.

The residual effects of the dressings applied to guineacorn in 1955 were tested on groundnuts. The results are given in Table 10.

TABLE 10.—RESIDUAL EFFECT OF FERTILISERS AND FARMYARD MANURE ON GROUNDNUTS, BADEGGI

Yields in lb. per acre Groundnut Kernels and Threshed Guineacorn Grain

<i>Treatment</i>	1956 <i>Residual G'nut Kernels</i>		1955 <i>G'corn Grain</i>	
	<i>No F. Y. M.</i>	<i>3 t. p. a. F. Y. M.</i>	<i>No F. Y. M.</i>	<i>3 t. p. a. F. Y. M.</i>
Nil	342	362	196	223
2 cwt Sulphate of Ammonia	258	423	479	255
2 cwt Superphosphate	290	473	212	434
2 cwt S.A. + 2 cwt Super	323	509	273	398
2 cwt S.A. + 3 cwt Super	473	280	219	201
2 cwt S.A. + 4 cwt Super	305	455	165	326
2 cwt S.A. + 2 cwt Super + $\frac{3}{4}$ cwt Muriate of Potash	341	420	461	380

There is some evidence of a residual effect on groundnut yields particularly on the plots receiving farmyard manure. Yields are reasonable for this area. The soils there appear to be suffering from a massive deficiency of available plant nutrients. Restoration with manure and fertilisers would not be economic and responses are lower than would be expected.

(d) *Samaru*.—Residual measurement of night soil compost and farmyard manure applications made in 1955 to guineacorn were tested on groundnuts. The results are given in Table 11.

TABLE 11.—RESIDUAL EFFECT OF NIGHT SOIL COMPOST AND FARMYARD MANURE ON GROUNDNUTS, SAMARU

Yields in lb. per acre

<i>Treatment</i>	1956 <i>Residual G'nut Kernels</i>	1955 <i>G'corn Grain</i>
Nil	***	**
3 t.p.a. Farmyard Manure	1,030	1,268
3 t.p.a. Night Soil Compost	1,192	1,676
6 t.p.a. Night Soil Compost	1,446	1,527
6 t.p.a. Night Soil Compost	1,596	1,558
S.E.	± 30	± 69

All the manures produced significant residual effects on the yield of groundnuts. The residual effect of night soil compost is much more marked than that of farmyard manure. This is probably due to the slower break down of the material in the compost as compared to the farmyard manure which is usually well rotted before use.

(4) *Permanent Manurial Trials on Groundnuts:*

(a) *Kano Province—Kano.*—A trial has been carried out at Kano since 1931 comparing the effects on groundnuts of continuous annual applications of farmyard manure at 3 tons per acre with no manure. The trial has now been concluded. The results for the twenty-six years are presented in Table 12.

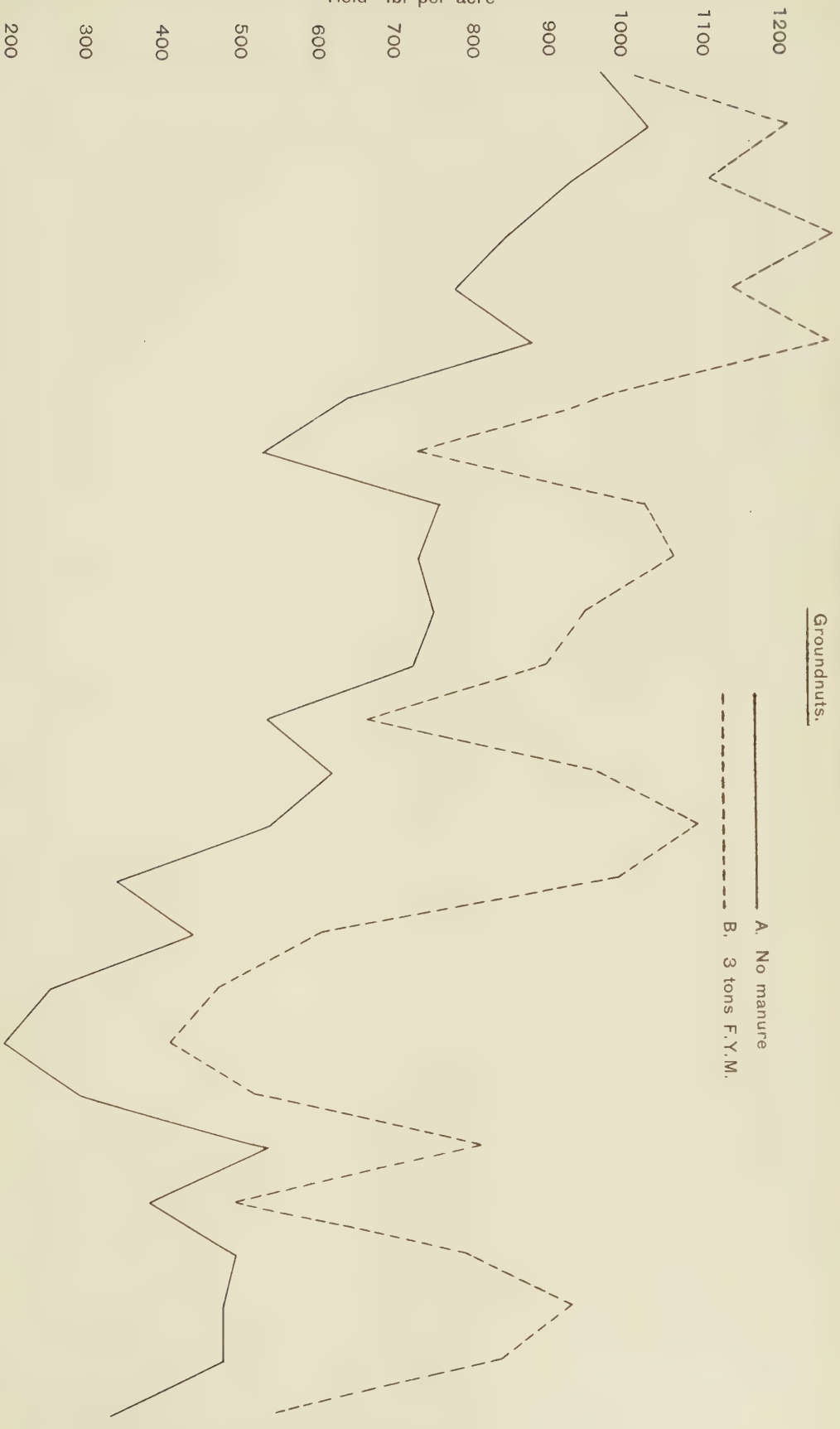
TABLE 12.—PERMANENT MANURIAL TRIAL ON GROUNDNUTS, KANO
Yields in lb. per acre Groundnuts Kernels

Year	Treatment		Increase of B Over A	S.E. $\pm$	Significance
	A No Manure	B 3 t.p.a. F.Y.M.			
1931	964	1,004	+40	71	Not significant
1932	1,027	1,209	+182	21	
1933	925	1,108	+183	29	
1934	843	1,266	+423	40	Highly significant
1935	774	1,138	+364	47	
1936	873	1,259	+386	55	
1937	632	966	+334	56	
1938	522	725	+203	48	
1939	752	1,020	+268	30	Significant
1940	724	1,056	+332	96	
1941	745	942	+197	39	
1942	715	890	+175	54	Significant
1943	525	657	+132	48	
1944	608	957	+379	34	Highly significant
1945	526	1,086	+560	77	
1946	326	981	+555	18	
1947	426	595	+169	42	
1948	238	458	+250	27	
1949	177	395	+218	24	Approaching significance
1950	276	503	+227	17	
1951	520	798	+278	21	
1952	365	475	+110	54	Highly significant
1953	478	776	+298	29	
1954	461	915	+454	41	
1955	460	825	+365	53	
1956	313	535	+212	31	

1300
1200
1100
1000
900
800
700
600
500
400
300
200
100
1931

Figure 1
Permanent Manurial Trial, Kano.
Groundnuts.

— A. No manure
- - - B. 3 tons F.Y.M.



The yields of both treatments have shown a general tendency to decline over the period of the trial. This is probably an effect of continuous monocropping; a trial at Samaru comparing monocropping with rotation of groundnuts has shown that groundnuts do better in a rotational cropping system. It is apparent that manuring with 3 tons per acre of farmyard manure per annum has not been able to reduce this monocropping effect so that decline in yields must be due to some factor other than available plant nutrients.

The plots receiving no manure have maintained yield remarkably well relative to the manured plots. The effect of season on yield is very marked and it is this aspect that shows up the greatest difference between the two treatments; the manured groundnuts were able to respond much more to a favourable season than were the unmanured groundnuts.

Regression coefficients were calculated for rainfall between 1st July and 31st October each year and yield of manured and unmanured plots.

Manure	...	...	...	...	...	b= 10.83 ***
No Manure	...	...	...	...	...	b= 11.51 ***

Daily rainfall figures are not available for the earlier years of the trial which necessitated using the arbitrary period from 1st July—31st October.

(5) *Permanent D.N.P.K. Trials on Groundnuts:*

These trials were initiated at several stations in 1949 and 1950 to investigate the long term effects of repeated annual dressings of farmyard manure, sulphate of ammonia, superphosphate and muriate of potash on local crop rotations. The effect of these dressings on the groundnut course of the rotations is given in Table 13.

The only positive responses are to farmyard manure and superphosphate; the responses to 1 ton of farmyard manure and 50 lb of superphosphate are virtually identical as also are the responses to 2 tons of farmyard manure and 100 lb of superphosphate. The response to nitrogen and potash is negative but the decrease is not large. The only positive interactions are between farmyard manure and nitrogen and farmyard manure and potash but these are not very substantial. The Dx K interaction is positive at all stations. The remaining interactions are negative but the effects are not large.

TABLE 13.—D.N.P.K., ON GROUNDNUTS
Yields in lb. Kernels per acre per annum

Number of years Groundnuts have been Test Crop	Daura	Kano	Maiduguri	Samaru	Weighted Mean Yield	Increase over Nil
	2	2	1	2		
<i>Farmyard Manure</i>						
D						
Nil	781	1,021	951	859	896	
1 ton per acre ...	958	1,228	968	1,095	1,076	+180
2 tons per acre ...	1,090	1,285	959	1,174	1,151	+255
<i>Sulphate of Ammonia N</i>						
Nil	990	1,176	985	1,077	1,067	
50 lb. per acre ...	919	1,206	944	1,031	1,037	—30
100 lb. per acre ...	920	1,152	949	1,020	1,019	—48
<i>Superphosphate P</i>						
Nil	697	1,063	955	901	897	
50 lb. per acre ...	994	1,207	965	1,077	1,074	+177
100 lb. per acre ...	1,138	1,264	958	1,150	1,152	+255
<i>Muriate of Potash K</i>						
Nil	975	1,168	972	1,053	1,052	
25 lb. per acre ...	969	1,171	976	1,040	1,048	—4
50 lb. per acre ...	884	1,194	929	1,036	1,022	—30
<i>Interactions (linear effect only)</i>						
DxN	+110	+41	—53	—30		
DxP	—74	—71	+9	—210	—100	
DxK	+82	+25	+15	+80	+56	
NxP	—4	—43	—27	—56	—33	
NxK	—85	—10	0	—6	—29	
PxK	+11	—30	—47	—6	—18	

Cultural Trials

(1) *Spacing Trial on Groundnuts—Samaru.*—This observation trial was carried out to investigate the effect on groundnut yields of various spacings on flat beds at different fertiliser levels. All previous work on groundnut spacings in Northern Nigeria has been carried out on ridges with uniform fertility levels. Under these conditions, optimum spacings have been thoroughly investigated, but they indicate very much lower plant populations than those which have been found optimal in certain other territories. Ridge cultivation is normally essential at Samaru, but it was decided to investigate (in the first place on an observational basis) denser populations where conditions of drainage could be produced which would permit flat cultivation. The corresponding observations on cotton and guineacorn are reported on pages 66 and 57.

The trial was late planted and yields were much below average; also the land used had just come out of fallow. The results are given in Table 14.

TABLE 14.—SPACING OF GROUNDNUTS ON BEDS, SAMARU
Yields in lb. per acre Groundnut Kernels

<i>Fertilisers per acre</i>	<i>Spacing</i>			<i>Mean Fertiliser</i>
	6"x6"	12"x6"	12"x12"	
Nil	341	514	363	406
1 cwt Superphosphate	618	686	417	574
2 cwt Superphosphate	584	806	664	685
1 cwt Super + 1 cwt S/A	615	550	640	602
2 cwt Super + 1 cwt S/A	473	559	754	595
Mean Spacing	526	623	568	—

12" X 6" spacing appears to be optimum and the main response appears to be due to superphosphate rather than to a combined N.P. dressing.

(2) *Ridge Versus Flat Cultivation of Groundnuts—Maiduguri, Bornu Province.* A trial comparing various groundnut varieties planted on the flat and on the ridge was repeated at Maiduguri. The results for the two years are presented in Table 15.

In neither year was there any significant difference between flat and ridge plantings. Twenty-eight trials have now been carried out in the Sudan Zone (mainly in Kano Province) comparing ridge and flat planting; nine of these showed significant results in favour of ridge planting; in none of the trials was the reverse the case. In view of these results it has been decided to discontinue this comparison of ridge and flat planting at Maiduguri. All future groundnut trials will be sown on ridges.

TABLE 15.—RIDGE VERSUS FLAT CULTIVATION OF GROUNDNUTS
MAIDUGURI
Yield in lb. Kernels per acre

<i>Treatment</i>	1956	1955
<i>Cultivation</i>	N.S.	N.S.
Ridged	615	841
Flat	614	795
S.E.	±30	±37
<i>Varieties</i>		
ML 378	569	849
Daura Local Spreading	694	790
Maiduguri Local Spreading	637	822
S. 38	600	849
K. 50	618	816
S.E.	134	158

Seed Dressing Trials

The effect of various proprietary seed dressing compounds on groundnut germination and yield was tested at four stations.

(1) *Samaru*.—The results for 1955 and 1956 are given in Table 16.

TABLE 16.—SEED DRESSING TRIAL ON GROUNDNUTS, SAMARU

Yields in lb. per acre Groundnut Kernels:

Stand Count at Harvest as Percentage of Maximum

<i>Treatment</i>	1956		1955	
	<i>Groundnut Kernels</i>	<i>Per cent Stands</i>	<i>Groundnut Kernels</i>	<i>Per cent Stands</i>
	N.S.	N.A.	N.S.	N.A.
Control	807	96.8	1,035	98.4
Fernasan A 0.2 per cent	844	97.0	1,016	98.5
Fernasan D 0.2 per cent	743	97.3	—	—
YF 4185 0.2 per cent	829	95.1	—	—
YF 4186 0.2 per cent	807	95.2	—	—
YF 4187 0.2 per cent	791	96.0	—	—
YF 3669 0.2 per cent	—	—	1,085	98.5
YF 3734 0.2 per cent	—	—	1,087	98.4
S.E.	±29		±36	

As in 1955, no significant results were obtained, yields were not as high as in 1956 but were still good.

The effect of overdressing groundnuts with various seed dressings was also tested at Samaru. The results of germination counts are given in Table 17. This trial was not carried through to harvest.

TABLE 17.—PHYTOTOXICITY OF SEED DRESSINGS ON GROUNDNUTS, SAMARU

Germination Counts as Percentage of Maximum

<i>Treatment</i>	<i>Germination Counts Number of days after Planting</i>		
	8 days	13 days	18 days
	N.S.	**	*
Control	56.3	84.6	86.4
Fernasan D 0.2 per cent	59.4	88.2	89.9
Fernasan D 0.3 per cent	61.4	88.9	90.2
Fernasan D 0.4 per cent	65.7	87.7	88.7
Fernasan D 0.6 per cent	67.4	83.9	86.4
YF 4187 0.2 per cent	63.9	88.4	89.7
YF 4187 0.6 per cent	62.1	88.6	88.9
YF 4188 0.2 per cent	67.7	88.7	90.4
YF 4188 0.6 per cent	74.3	90.7	91.4
Fernasan A 0.6 per cent	71.7	88.7	89.9
S.E.	±5.1	±1.0	±1.0

Fernasan D at 0.6 per cent had significantly fewer stands than the other levels of Fernasan D tested, but as it did not differ significantly from control.

the toxicity of this over-dressing cannot be regarded as serious. As all the other dressings show better stand counts than control, no deleterious effect on germination can have occurred. In practice, if proper mixing of seed dressing and groundnut seed is carried out it is considered unlikely that seed dressing could be applied at a higher concentration to the seed than 0.6 per cent weight per weight.

(2) *Kano Province—Kano.*—The results for 1955 and 1956 are given in Table 18.

TABLE 18.—SEED DRESSING TRIAL ON GROUNDNUTS, KANO

*Yields in lb. per acre Kernels:
Stand Count at Harvest as Percentage of Maximum*

<i>Treatment</i>	1956		1955	
	<i>Groundnut Kernels</i>	<i>Per cent Stands</i>	<i>Groundnut Kernels</i>	<i>Per cent Stands</i>
Control	N.S. 907	N.A. 92.36	N.S. 1,143	N.A. 83.44
Fernasan A 0.2 per cent	948	91.53	1,166	89.31
Fernasan D 0.2 per cent	981	91.32	1,164	92.36
Fernasan D 0.3 per cent	1,052	89.05	—	—
YF 4187 0.2 per cent	872	89.26	—	—
YF 3669 0.2 per cent	—	—	1,150	88.96
YF 3734 0.2 per cent	—	—	1,154	86.35
S.E.	±64	—	±42	—

Once again no significant results were obtained; however, there is a yield trend in favour of seed dressed with Fernasan D.

(3) *Sokoto Province (a) Kasarawa.*—The results for 1955 and 1956 are given in Table 19.

TABLE 19.—SEED DRESSING TRIAL ON GROUNDNUTS, KASARAWA

*Yields in lb. per acre Kernels:
Stand Count at Harvest as Percentage of Maximum*

<i>Treatment</i>	1956		1955	
	<i>Groundnut Kernels</i>	<i>Per cent Stands</i>	<i>Groundnut Kernels</i>	<i>Per cent Stands</i>
Control	N.S. 639	N.S. 65	*	N.A. 70.9
Fernasan A 0.2 per cent	659	68	783	76.9
Fernasan D 0.2 per cent	607	64	737	78.0
YF 4187	729	66	—	—
Agrosan GN.	674	63	—	—
YF 3669	—	—	795	77.1
YF 3734	—	—	760	80.6
S.E.	±38	±2	±134	—

No significant results were obtained this year.

(b) *Gusau*.—This trial was conducted for the first year. The results are given in Table 20.

TABLE 20.—SEED DRESSING TRIAL ON GROUNDNUTS, GUSAU
Yields in lb. per acre Kernels:
Stand Count at Harvest as Percentage of Maximum

<i>Treatment</i>	<i>Groundnut Kernels</i>	<i>Stands %</i>
Control	N.S. 456	N.A. 78
Fernasan A 0.2%	493	87
Fernasan D 0.2%	464	85
Fernasan D 0.3%	490	88
YF 4187	533	84
S.E.	±34	—

In this trial there was a non-significant trend in favour of seed dressings for both yield and stand count. Yields were below average for Gusau, probably due to the season.

(4) *General*.—A total of seven trials of seed dressings on groundnuts have been carried out over two years. Only one significant result has been obtained to date in favour of dressed seed (at Kasarawa in 1955). A summary of the results for specific seed dressings is given in Table 21.

TABLE 21.—EFFECT OF SEED DRESSINGS ON GROUNDNUT YIELDS:
COMBINED RESULTS
Yield in lb. per acre of Groundnut Kernels

<i>Treatment</i>	<i>No. of Trials</i>	<i>No. of Seasons</i>	<i>Mean Yield</i>	<i>Increase Over Control</i>
Control	7	2	796	—
Fernasan A 0.2%	7	2	844	+48
Fernasan D 0.2%	7	2	826	+30
Fernasan D 0.3%	3	1	762	—34
Agrosan GN	1	1	674	—122
YF 4185	1	1	829	+33
YF 4186	1	1	807	+11
YF 4187	4	1	731	—65
YF 3669	3	1	1,010	+214
YF 3734	3	1	1,000	+204

The figures presented above do not give a true picture as those dressings tested only in 1955 show up better than those tested only in 1956 due to growing conditions being more favourable in 1955; other compounds have only been tested at stations which give low yields.

The position regarding seed dressings on groundnuts would appear to be that they do little to increase groundnut yields and can at best be regarded as insurance against abnormal conditions.

The real effect of seed dressings on groundnut germination may have been rather obscured by the departmental practice of sowing two seeds per stand; this has been done on all the recent trials but is being rectified in future trials.

Deterioration of Groundnut Seed, Katsina Province—Daura.—As reported in the 1954 and 1955 annual report, varieties of groundnuts introduced to Daura deteriorate markedly in performance after the first season. The possibility that storage under high temperature conditions during the dry season may be responsible was examined during 1956. Seed of the variety Castle Cary grown at Samaru, was stored during the dry season at Samaru and at Daura; these were both grown at Daura and compared with Daura Local Spreading in an observation trial. The results are given in Table 22.

TABLE 22.—GROUNDNUT STORAGE TRIAL, DAURA
Yield in lb. per acre Groundnut Kernels

<i>Treatment</i>											<i>G'nut kernels</i>
											N.A.
Daura Local	...	...	...	...	...	...	...	...	...	...	784
Castle Cary stored Samaru	...	...	...	...	...	...	...	...	...	...	660
Castle Cary stored Daura	...	...	...	...	...	...	...	...	...	...	556

There is a trend in yield in favour of Castle Cary stored at Samaru compared to the same variety stored at Daura. Daura Local, as usual, outyielded both types of Castle Cary.

Germination counts showed no difference between the two types of Castle Cary; also there was no difference between germination tests.

GUINEACORN

Fertiliser Trials

(1) *Nitrogen and Phosphate Trials on Guineacorn:*

(a) *Niger Province—Lapai.*—A trial was conducted for the first year on farmers' plots at Lapai. The results are presented in Table 23.

TABLE 23.—NITROGEN AND PHOSPHATE ON GUINEACORN, LAPAI
Yields in lb. Threshed Grain per acre

Treatment												Grain
<i>Sulphate of Ammonia:</i>												***
Nil	...	...	...	...	...	...	...	...	...	...	...	648
$\frac{1}{2}$ cwt per acre	...	...	...	...	...	...	...	...	...	...	...	783
1 cwt per acre	...	...	...	...	...	...	...	...	...	...	...	797
<i>Superphosphate</i>												***
Nil	...	...	...	...	...	...	...	...	...	...	...	604
$\frac{1}{2}$ cwt per acre	...	...	...	...	...	...	...	...	...	...	...	777
1 cwt per acre	...	...	...	...	...	...	...	...	...	...	...	848
S.E.	...	...	...	...	...	...	...	...	...	...	...	±26

Interaction NxP. N.S.

											<i>Sulphate of Ammonia</i>		
											<i>Nil</i>	$\frac{1}{2}$ cwt	1 cwt
<i>Superphosphate</i>													
Nil	...	...	...	...	...	...	...	...	...	...	475	675	663
$\frac{1}{2}$ cwt	...	...	...	...	...	...	...	...	...	...	689	810	823
1 cwt	...	...	...	...	...	...	...	...	...	...	773	865	908

Response to both fertilisers was significant with superphosphate producing the most marked response.

(b) *Plateau Province—Kanam.*—This was the third year of this trial. The results are presented in Table 24.

TABLE 24.—NITROGEN AND PHOSPHATE ON GUINEACORN, KANAM
Yields in lb. Threshed Grain per acre

Treatment											1956	1955	1954
											Grain	Grain	Grain
<i>Sulphate of Ammonia:</i>											*	***	***
Nil	...	...	...	...	...	...	...	...	...	...	1,101	601	592
$\frac{1}{2}$ cwt per acre	...	...	...	...	...	...	...	...	...	...	1,151	681	768
1 cwt per acre	...	...	...	...	...	...	...	...	...	...	1,279	803	796
<i>Superphosphate:</i>											N.S.	***	***
Nil	...	...	...	...	...	...	...	...	...	...	1,086	556	623
$\frac{1}{2}$ cwt per acre	...	...	...	...	...	...	...	...	...	...	1,208	779	748
1 cwt per acre	...	...	...	...	...	...	...	...	...	...	1,238	750	895
S.E.	...	...	...	...	...	...	...	...	...	...	±51	±28	±30

In none of the three years has the interaction been significant. This year sulphate of ammonia produced the only significant effect, 1 cwt per

acre being significantly better than nil. Yields were very much higher on all treatments this year, possibly higher fertility on the site used this year has masked the effects of the fertilisers.

Andaha.—This was the third year of the trial. The results are presented in Table 25.

TABLE 25.—NITROGEN AND PHOSPHATE ON GUINEACORN, ANDAHA
Yields in lb. Threshed Grain per acre

<i>Treatment</i>	1956	1955	1954
	<i>Grain</i>	<i>Grain</i>	<i>Grain</i>
<i>Sulphate of Ammonia:</i>	***	N.S.	*
Nil	295	549	514
$\frac{1}{2}$ cwt per acre	420	589	602
1 cwt per acre	488	604	584
<i>Superphosphate:</i>	N.S.	**	N.S.
Nil	379	496	530
$\frac{1}{2}$ cwt per acre	406	612	557
1 cwt per acre	418	635	613
S.E.	± 29	± 36	± 24

The NxP interaction has not been significant in any of the three years.

Results of this series have been most inconsistent; yields in all three years have been low but 1956 yields were even lower than usual due to drought.

Langtang.—This trial has also completed three years. Results are given in Table 26.

TABLE 26.—NITROGEN AND PHOSPHATE ON GUINEACORN, LANGTANG
Yields in lb. Threshed Grain per acre

<i>Treatment</i>	1956	1955	1954
	<i>Grain</i>	<i>Grain</i>	<i>Grain</i>
<i>Sulphate of Ammonia:</i>	***	***	*
Nil	288	282	178
$\frac{1}{2}$ cwt per acre	359	364	218
1 cwt per acre	417	411	231
<i>Superphosphate:</i>	***	*	N.S.
Nil	315	348	207
$\frac{1}{2}$ cwt per acre	364	338	212
1 cwt per acre	385	371	208
S.E.	± 13	± 10	± 13

The NxP interaction was positive and highly significant in 1955; it was not significant in either 1954 or 1956.

The response to sulphate of ammonia has been consistent over the three years of the trial; superphosphate produced its greatest effect this year.

Yields have been consistently low in every year of this trial, and it is doubtful whether economic fertiliser application can be made in this area if these yields and responses are typical.

Kurgwi.—This trial was conducted for one year only to confirm the results of the trials at Langtang and Kanam. The results are given in Table 27.

TABLE 27.—NITROGEN AND PHOSPHATE ON GUINEACORN, KURIGWI
Yields in lb. Threshed Grain per acre

Treatment											Grain
<i>Sulphate of Ammonia:</i>											*
Nil	...	...	...	...	...	...	...	...	...	...	739
$\frac{1}{2}$ cwt per acre	...	...	...	...	...	...	...	...	...	...	827
1 cwt per acre	...	...	...	...	...	...	...	...	...	...	849
<i>Superphosphate:</i>											***
Nil	...	...	...	...	...	...	...	...	...	...	600
$\frac{1}{2}$ cwt per acre	...	...	...	...	...	...	...	...	...	...	866
1 cwt per acre	...	...	...	...	...	...	...	...	...	...	950
S.E.	...	...	...	...	...	...	...	...	...	...	±28

Interaction NxP.

N.S.

										<i>Sulphate of Ammonia</i>		
										<i>Nil</i>	$\frac{1}{2}$ cwt	1 cwt
<i>Superphosphate</i>												
Nil	...	...	...	...	...	...	...	...	...	625	601	573
$\frac{1}{2}$ cwt	...	...	...	...	...	...	...	...	...	762	888	949
1 cwt	...	...	...	...	...	...	...	...	...	831	993	1,024

The effect of superphosphate is highly significant both $\frac{1}{2}$ and 1 cwt being better than nil and 1 cwt being better than $\frac{1}{2}$ cwt. The sulphate of ammonia effect is much less, both levels being better than nil but there is no significant difference between the two rates.

(c) *Benue Province—Mbatie.*—Although this trial was initiated in 1953, in two years only has it been successful. The results for 1955 and 1956 are given in Table 28.

TABLE 28.—NITROGEN AND PHOSPHATE ON GUINEACORN, MBATIE
Yields in lb. Threshed Grain per acre

<i>Treatment</i>										1956	1955
										<i>Grain</i>	<i>Grain</i>
<i>Sulphate of Ammonia:</i>										<i>N.S.</i>	<i>N.S.</i>
Nil	...	...	...	...	...	...	...	...	...	528	810
$\frac{1}{2}$ cwt per acre	...	...	...	...	...	...	...	...	...	495	751
1 cwt per acre	...	...	...	...	...	...	...	...	...	535	775
<i>Superphosphate:</i>										<i>N.S.</i>	<i>***</i>
Nil	...	...	...	...	...	...	...	...	...	454	506
$\frac{1}{2}$ cwt per acre	...	...	...	...	...	...	...	...	...	580	838
1 cwt per acre	...	...	...	...	...	...	...	...	...	524	992
S.E.	...	...	...	...	...	...	...	...	...	± 68	± 44

In neither year was the NxP interaction significant.

The marked response to superphosphate obtained in 1955 was not repeated although there is still a slight trend in favour of superphosphate. Yields are much lower than in 1955 due to drought.

(d) *Adamawa Province—Mubi.*—This trial was carried out for the second year. The results are given in Table 29.

TABLE 29.—NITROGEN AND PHOSPHATE ON GUINEACORN, MUBI
Yields in lb. Threshed Grain per acre

<i>Treatment</i>										1956	1955
										<i>Grain</i>	<i>Grain</i>
<i>Sulphate of Ammonia:</i>										<i>N.S.</i>	***
Nil	...	...	...	...	...	...	...	...	...	543	289
$\frac{1}{2}$ cwt per acre	...	...	...	...	...	...	...	...	...	580	526
1 cwt per acre	...	...	...	...	...	...	...	...	...	644	584
<i>Superphosphate:</i>										***	<i>N.S.</i>
Nil	...	...	...	...	...	...	...	...	...	489	426
$\frac{1}{2}$ cwt per acre	...	...	...	...	...	...	...	...	...	591	458
1 cwt per acre	...	...	...	...	...	...	...	...	...	687	516
S.E.	...	...	...	...	...	...	...	...	...	± 31	± 45

The NxP interaction was not significant in either year. The highly significant response to sulphate of ammonia obtained in 1955 was not repeated; however there is still a trend in its favour. The response to superphosphate this year was very marked.

(e) *Ilorin Province—Lafiagi.*—This trial was carried out for the first time. The guineacorn in this trial was interplanted with maiwa but the latter failed due to drought. The fertilisers were applied to the guineacorn. The results for guineacorn are given in Table 30.

TABLE 30.—NITROGEN AND PHOSPHATE I.P.W. MAIWA, LAFIAGI

Yields in lb. Threshed Grain per acre

<i>Treatment</i>											<i>Grain</i>
<i>Sulphate of Ammonia:</i>											***
Nil	...	...	...	...	...	...	...	...	...	...	229
$\frac{1}{2}$ cwt per acre	...	...	...	...	...	...	...	...	...	...	330
1 cwt per acre	...	...	...	...	...	...	...	...	...	...	423
<i>Superphosphate:</i>											N.S.
Nil	...	...	...	...	...	...	...	...	...	...	345
$\frac{1}{2}$ cwt per acre	...	...	...	...	...	...	...	...	...	...	338
1 cwt per acre	...	...	...	...	...	...	...	...	...	...	300
S.E.	...	...	...	...	...	...	...	...	...	...	±24

*NxP interaction**N.S.*

<i>Superphosphate</i>								<i>Sulphate of Ammonia</i>		
								Nil	$\frac{1}{2}$ cwt.	1 cwt.
Nil	...	...	...	...	...	...	...	219	340	476
$\frac{1}{2}$ cwt	...	...	...	...	...	...	...	287	310	416
1 cwt	...	...	...	...	...	...	...	181	340	378

Sulphate of ammonia produced the only significant effects. Yields were low due to drought.

(f) *General*.—All the N and P trials carried out on guineacorn during 1956 were in the Middle Belt. Examination of the results of this year's and previous trials indicate that the main response is to sulphate of ammonia; in some cases there is a response to superphosphate but this is less consistent. In none of the trials was the NxP interaction significant although there are indications of a trend in favour of an interaction. Yields on the majority of these trials were below average this year due to drought.

(2) *Residual Effect of Fertilisers on Guineacorn:*

(a) *Kabba Province—Osara*.—A trial was carried out to investigate the effect on guineacorn yields of the residual effect of fertilisers applied to yams in 1955. The results are given in Table 31.

TABLE 31.—RESIDUAL EFFECT OF NITROGEN AND PHOSPHATE ON GUINEACORN, OSARA

Yields in lb. Threshed Grain per acre

Treatment											Grain
<i>Sulphate of Ammonia:</i>											N.S.
Nil	...	...	...	...	...	...	...	...	...	...	305
1 cwt per acre	...	...	...	...	...	...	...	...	...	...	321
2 cwt per acre	...	...	...	...	...	...	...	...	...	...	301
S.E.	...	...	...	...	...	...	...	...	...	...	±19
<i>Superphosphate:</i>											**
Nil	...	...	...	...	...	...	...	...	...	...	284
1 cwt per acre	...	...	...	...	...	...	...	...	...	...	334
S.E.	...	...	...	...	...	...	...	...	...	...	±16

The fertilisers applied to yams in 1955 produced no significant results. In 1956 the superphosphate produced a significant residual effect on guineacorn but yields were very low due to drought.

(b) *Adamawa Province—Yola.*—Guineacorn was used to measure the residual effect of fertilisers applied to groundnuts in 1955. The results are given in Table 32.

TABLE 32.—RESIDUAL EFFECTS OF NITROGEN AND PHOSPHATE ON GUINEACORN, YOLA

Yields in lb. Threshed Grain per acre

Treatment											Grain
<i>Sulphate of Ammonia:</i>											N.S.
Nil	...	...	...	...	...	...	...	...	...	...	982
1 cwt per acre	...	...	...	...	...	...	...	...	...	...	992
2 cwt per acre	...	...	...	...	...	...	...	...	...	...	986
S.E.	...	...	...	...	...	...	...	...	...	...	±33
<i>Superphosphate:</i>											***
Nil	...	...	...	...	...	...	...	...	...	...	862
1 cwt per acre	...	...	...	...	...	...	...	...	...	...	882
2 cwt per care	...	...	...	...	...	...	...	...	...	...	1,036
3 cwt per acre	...	...	...	...	...	...	...	...	...	...	1,166
S.E.	...	...	...	...	...	...	...	...	...	...	±39

In 1955 neither fertiliser produced any significant effects on groundnut kernel yields although their effects on haulms were significant. In 1956 both 2 and 3 cwt of superphosphate per acre produced significant increases in yield.

3. *Permanent Manurial Trials on Guineacorn:*

(a) *Kano Province—Kano.*—(i) The trial at Kano which has been in

progress since 1950 to test the effect of different levels of farmyard manure on guineacorn yields on land which had previously grown guineacorn for nineteen years with 3 tons of farmyard manure per acre per annum continued. The results to date are presented in Table 33.

TABLE 33.—PERMANENT FARMYARD MANURE TRIAL ON GUINEACORN,
KANO

Yields in lb. Threshed Grain per acre

<i>Treatment</i>	1956	1955	1954	1953	1952	1951	1950
<i>Farmyard Manure:</i>	***	***	***	***	**	N.S.	*
Nil	80	22	76	330	584	813	539
1 t.p.a. each year ...	327	224	398	670	799	918	608
2 t.p.a. each year ...	237	162	543	818	863	986	665
3 t.p.a. each year ...	341	299	783	893	1,053	974	816
2 t.p.a. every third year	185	68	261	626	876	829	693
3 t.p.a. every third year	266	115	364	776	979	1,032	828
S.E.	±33	±33	±54	±67	±52	±77	±66

Note.—The plots receiving farmyard manure every third year received applications in 1950, 1953 and 1956.

The differences between treatments has remained consistent. The plots receiving farmyard manure every third year have shown a marked response to the application made this year. However yields on all plots are still very low; the slight increase in yield on all plots in 1956 is the first upward trend in yield since 1951. The effect of twenty-six years of continuous guineacorn is obviously producing an effect on yield which cannot be masked by continuous applications of farmyard manure.

The results are presented graphically in Figure 2 for the applications made each year only.

(ii) The related permanent trial at Kano on land which had previously grown guineacorn for nineteen years without manure, comparing the effect of fertiliser mixtures and farmyard manure on restoration of fertility was continued in 1956 using millet as the test crop. The decision to change from guineacorn to millet was made due to the virtually complete failure of guineacorn on all treatments in 1954 and 1955. It was thought that growing millet instead of guineacorn might overcome the effects of monocropping of guineacorn. This did not prove to be true as the millet crop was a complete failure on all treatments; vegetative growth was satisfactory but no grain was set; this may have been due in part to late planting and generally unfavourable growing conditions. The results are presented in Table 34.

Figure 2

Permanent Manurial Trial on Guinea-corn, Kano



— = No Manure

- - - = 1 ton

... = 2 tons

- . - . = 3 tons

TABLE 34.—PERMANENT MANURE AND FERTILISER TRIAL ON GUINEACORN, KANO

Yields in lb. Threshed Grain per acre

<i>Treatment per acre</i>	1956 (Millet)	1955 <i>G'corn</i>	1954 <i>G'corn</i>	1953 <i>G'corn</i>	1952 <i>G'corn</i>	1951 <i>G'corn</i>	1950 <i>G'corn</i>
Nil	—	—	—	16	133	272	—
75 lb. Sul. of Ammonia	—	—	—	106	155	266	—
150 lb. Superphosphate	—	—	—	91	207	389	36
50 lb. Muriate of Potash	—	—	—	81	173	321	—
75 lb. S.A. + 150 lb P	—	—	—	175	205	450	33
3 tons F.Y.M. ...	—	157	482	372	491	616	247
S.E.	—	—	—	±31	±14	±34	—

Indications from this trial are that some factor other than the level of the main nutrients must be considered. Minor element treatments are being tried in 1957; checks for nematodes are also being made. Seasonal influences seem to be able to bring yields up regardless of the fertiliser or manurial treatment.

(4) *Permanent D.N.P.K. Trials on Guinea-corn:*

These trials were initiated at several stations in 1949 or 1950 to investigate the long term effects of repeated annual dressings of farmyard manure, sulphate of ammonia, superphosphate and muriate of potash on local crop rotations. The effect of these dressings on guineacorn (and in some cases interplanted, or sole millet) is given in Table 35.

The main response has been to farmyard manure with 2 tons giving a substantial increase over one ton. Sulphate of ammonia and superphosphate have produced responses of about the same order, and in both cases there is little advantage for the higher rate over the lower rate. Muriate of potash has produced virtually no response and there is indication of a depression in yield if the higher rate is used. The interactions show very little except in the case of D x P where the overall effect is negative, phosphate tending to reduce the effect of farmyard manure; the P x K interaction is similar, muriate of potash reducing the effect of phosphate. The N x P interaction on the other hand tends to be positive.

TABLE 35.—D.N.P.K., ON GUINEACORN AND MILLET
Yields in lb. Threshed Grain per acre per Annum

Station	Bida	Daudawa	Daura	Kano	Maiduguri	Samaru	Yandev		
No. of years in which G'corn and/or Millet has been test crop ...	3	2	4	6	3	2	2		
Whether sole or i. p. w. millet	Sole	Sole	+ Millet	Sole	Millet only	Sole	+ Millet	Weighted Mean Yield	Increase over Nil
<i>Farmyard Manure D</i>									
Nil ...	784	836	516	835	1,182	1,071	527	817	—
1 ton per acre	1,066	1,026	640	1,183	1,271	1,350	723	1,038	+221
2 tons per acre	1,272	1,139	766	1,378	1,319	1,511	830	1,184	+367
<i>S. of Ammonia N</i>									
Nil ...	926	880	586	1,059	1,170	1,206	661	934	—
50 lb. per acre	1,098	1,034	647	1,163	1,260	1,321	709	1,035	+101
100 lb. per acre	1,097	1,087	691	1,173	1,345	1,405	709	1,070	+136
<i>Superphosphate P</i>									
Nil ...	771	952	499	1,083	1,169	1,199	602	905	—
50 lb. per acre	1,124	1,026	673	1,125	1,300	1,371	749	1,045	+140
100 lb. per acre	1,228	1,023	751	1,187	1,306	1,361	728	1,089	+184
<i>Muriate of Potash K</i>									
Nil ...	1,021	977	627	1,142	1,243	1,337	677	1,007	—
25 lb. per acre	1,058	1,016	655	1,138	1,255	1,289	725	1,021	+14
50 lb. per acre	1,042	1,008	641	1,115	1,276	1,306	678	1,011	+4
<i>Interaction (linear effect only)</i>									
DxN ...	+112	+5	+2	+42	+12	—48	+23	+27	
DxP ...	—89	—73	—93	—98	—50	—161	+31	—77	
DxK ...	—74	—1	+41	—15	—55	+203	+71	+6	
NxP ...	—24	—12	+28	+123	—2	+19	+6	+35	
NxK ...	—6	+28	—5	+11	+86	—84	—10	+4	
PxK ...	—57	+7	+10	+103	—16	—32	+25	—34	

Note: At Maiduguri the millet is interplanted with cowpeas; for Daura and Yandev the yield figures given represent the combined yield of guineacorn and millet grain.

At Yola a permanent D.N.P., trial was continued; the effects of the applications of farmyard manure, sulphate of ammonia and superphosphate in general follow the pattern shown in Table 35, the only marked difference is that the D x P interaction on guineacorn was positive.

Cultural Trials

(1) *Spacing Trial on Guineacorn—Samaru.*—An observation trial was carried out at Samaru to investigate the effect on guineacorn yields of various spacings on flat beds at different fertiliser levels. Previous work on guinea-

corn spacings in Northern Nigeria has been on ridges with uniform fertility levels. The trial was late planted and yields were below average. The results are given in Table 36.

TABLE 36.—SPACING OF GUINEACORN ON FLAT BEDS, SAMARU

Fertiliser per acre	Spacing			Mean Fertiliser
	12"x12"	24"x9"	24"x18	
il	217	172	584	324
cwt Superphosphate	303	1,036	418	586
cwt Superphosphate	549	412	667	543
cwt Super + 1 cwt S/A	868	477	618	654
cwt Super + 2 cwt S/A	690	679	746	705
cwt Super + 1 cwt S/A	713	743	1,043	833
cwt Super + 2 cwt S/A	737	1,101	1,533	1,123
Mean Spacing	582	660	801	

The wider spacings produced the highest yields, even at the highest levels of fertiliser application. The number of plants per acre with single plants at 24" x 18" is 14,520 which is exactly the same as the number of plants per acre with the conventional spacing of two plants per stand every 4 inches on 36-inch ridges. There were very marked variations within plots which probably biased the results of this trial.

(2) *Striga senegalensis* on Guineacorn.—Various trials were carried out to investigate the effects of *Striga senegalensis* on guineacorn yields and to examine methods of eradication.

(a) Benue Province—Yandev.—Effect of *Striga* on Guineacorn Yields

This trial was continued but due to drought the guineacorn crop was almost a complete failure. The results for *Striga* counts and comparative data for 1955 and 1954 are given in Table 37.

TABLE 37.—EFFECT OF STRIGA ON GUINEACORN, YANDEV
Yields in lb. Threshed Grain per acre
Striga Counts per acre

Treatment	1956		1955		1954	
	Grain	Striga	Grain	Striga	Grain	Striga
F.Y.M. per acre	N.A.	N.A.	***	N.A.	***	N.A.
1	2	28,318	8	17,552	169	53,268
ons	16	48,191	123	29,463	459	77,549
tons	68	53,176	367	30,324	800	75,965
S.E.	—	—	±25	—	±53	—
Hand-pulling of Striga	N.A.		**		***	
illed	24	56,068	114	54,696	751	111,750
ot pulled	34	37,053	218	2,2643	452	26,297
S.E.	—		±20		±38	

In 1955 the plots on which *Striga* had been hand-pulled for three years were changed over with the not-pulled plots. It is noticeable that the *Striga* population on the not-pulled plots has shown an increase since the change over. On the other hand the second year of hand-pulling has not managed to reduce the *Striga* population below the 1955 level.

Control of Striga.—The trial at Yandev testing various methods of controlling *Striga* was repeated for the second year. Drought reduced the yields considerably on all treatments. The treatments tested are:

- (i) Control—no treatment
- (ii) Transplanting of guineacorn seedlings
- (iii) Hand-pulling of *Striga*
- (iv) Spraying with Agroxone 4

Transplanting of seedlings failed completely in 1956. The results for the two years are given in Table 38.

TABLE 38.—CONTROL OF STRIGA IN GUINEACORN—YANDEV
Yields in lb. Threshed Grain per acre

<i>Treatment</i>	1956	1955
	<i>Grain</i>	<i>Grain</i>
Control	N.S. 221	N.S. 603
Transplanting	—	589
Hand-pulling	272	780
Agroxone 4	254	746
S.E.	±27	±111

There were practically no *striga* plants on plots in 1956

(b) *Samaru—Effect of Striga on Guineacorn Yields.*—The trial at Samaru designed to separate the two effects (i) reduction of yields due to monoculture and low fertility and (ii) reduction of yields due to the direct effect of *Striga* parasitism, was continued. The grain yields and *Striga* counts for 1954, 1955 and 1956 are presented in Table 39.

TABLE 39.—EFFECT OF STRIGA ON GUINEACORN, SAMARU

Yields in lb. Threshed Grain per acre:

Striga Counts per acre

<i>Treatment</i>	1956		1955		1954	
	<i>Grain</i>	<i>Striga</i>	<i>Grain</i>	<i>Striga</i>	<i>Grain</i>	<i>Striga</i>
<i>F.Y.M. per acre</i>	***	*	***	N.S.	***	***
oil	429	1,225	426	6,505	321	4,208
tons	1,281	1,880	1,190	4,691	1,072	8,833
<i>Hand-pulling of Striga</i>						
... ..	N.S.	***	N.S.	N.S.	N.S.	N.S.
... ..	855	6,191	799	5,964	723	3,188
... ..	855	2,486	816	5,233	670	9,853
<i>Striga Infection</i>						
... ..	N.S.	N.S.	N.S.	**	*	***
... ..	881	1,781	826	8,040	591	9,466
... ..	829	1,324	789	3,156	802	3,574
S.E.	±26	±210	±30	±1,009	±55	±627

Striga populations are still too low to have any appreciable effect on yield. The plots receiving no farmyard manure are maintaining yield at a reduced level.

Infection of plots with Striga seed has not increased striga populations to any appreciable extent. Presumably the seed is remaining dormant in the soil.

Seed Dressing Trials on Guinea-corn

The effect of various proprietary seed dressing compounds on guineacorn germination and yield were tested at five stations.

1. *Samaru*.—The results for 1955 and 1956 are given in Table 40.

Larvae of a Melolonthid beetle were abundant but in contrast to the millet seed dressing trial (page 70) did not appear to do much damage. The effect of Fernasan A (fungicide only) indicates that in this trial the beneficial effect was mainly exercised by the fungicide although the insecticides also helped.

TABLE 40.—SEED DRESSINGS ON GUINEACORN, SAMARU

Yields in lb. Grain per acre:
Stand Counts at Harvest as Percentage of Maximum

<i>Treatment</i>	1956		1955	
	<i>Grain</i>	<i>Per cent Stands</i>	<i>Grain</i>	<i>Per cent Stands</i>
	*	N.A.	N.S.	N.A.
Control	1,082	57.6	1,036	97.3
Fernasan A 0.15 per cent	1,325	96.7	992	99.1
Fernasan D 0.2 per cent	1,376	98.9	—	—
Fernasan D 0.3 per cent	1,350	99.5	917	99.5
Fernasan D 0.6 per cent	1,355	99.5	—	—
YF 3670 0.2 per cent	—	—	1,026	99.8
YF 3670 0.3 per cent	—	—	1,103	99.4
YF 4183 0.2 per cent	1,340	98.4	—	—
YF 4184 0.2 per cent	1,419	99.5	—	—
S.E.	±71	—	±50	—

Note: The YF preparations represent various insecticide and fungicide dressings supplied by Plant Protection, Ltd.

A subsidiary trial was carried out to compare the newer seed dressings with copper carbonate which was previously recommended for control of grain smut on guineacorn. The results are given in Table 41.

TABLE 41.—SEED DRESSINGS ON GUINEACORN, SAMARU

Yields in lb. Threshed Grain per acre
Stand Counts at Harvest as Percentage of Maximum

<i>Treatment</i>	<i>Grain</i>	<i>Per cent Stands</i>
	N.S.	
Control	968	93.3
Copper carbonate 0.3 per cent	996	91.7
Fernasan A 0.15 per cent	1,162	98.9
Fernasan D 0.2 per cent	991	98.5
S.E.	±84	—

No significant results were obtained. The stand count figures favour Fernasan A and Fernasan D compared to copper carbonate. This trial was late planted when conditions for germination were good.

2. *Kano Province—Kano.*—The results for 1955 and 1956 are presented in Table 42.

TABLE 42.—SEED DRESSINGS ON GUINEACORN, KANO
Yields in lb. Threshed Grain per acre:
Stand Counts at Harvest as Percentages of Maximum

<i>Treatment</i>	1956		1955	
	<i>Grain</i>	<i>Per cent Stands</i>	<i>Grain</i>	<i>Per cent Stands</i>
	N.S.	N.A.	N.S.	N.A.
Control	1,421	79.6	910	98.8
Fernasan A 0.15 per cent	1,471	75.9	1,120	97.8
Fernasan D 0.3 per cent	1,476	76.9	1,050	98.7
Fernasan D 0.6 per cent	1,507	63.4	—	—
YF 3670 0.2 per cent	—	—	1,114	98.1
YF 3760 0.3 per cent	—	—	1,163	97.6
YF 4183 0.2 per cent	1,425	76.9	—	—
S.E.	±74	—	±70	—

No significant results were obtained again this year; yields were exceptionally good. Fernasan D 0.6 per cent retarded germination initially compared to the other treatments, but it improved later; this did not affect final yields.

3. *Sokoto Province—(a) Kasarawa.*—Results for 1955 and 1956 are given in Table 43.

TABLE 43.—SEED DRESSINGS ON GUINEACORN, KASARAWA
Yields in lb. Threshed Grain per acre:
Stand Counts as Percentages of Maximum

<i>Treatment</i>	1956		1955	
	<i>Grain</i>	<i>Per cent Stands</i>	<i>Grain</i>	<i>Per cent Stands</i>
	N.S.	N.A.	N.S.	N.A.
Control	688	86.9	536	44.6
Fernasan A 0.15 per cent	774	93.0	674	52.3
Fernasan D 0.3 per cent	651	98.1	514	55.3
Fernasan D 0.4 per cent	—	—	622	53.1
Fernasan D 0.6 per cent	806	95.9	—	—
YF 3760 0.3 per cent	—	—	588	49.7
YF 4183 0.2 per cent	701	96.2	—	—
S.E.	±52	—	±48	—

No significant results were obtained. There is a trend in favour of treated seed for stand count as compared to the untreated control.

(b) *Gusau*.—This was the first year of this trial. The results are given in Table 44.

TABLE 44.—SEED DRESSING ON GUINEACORN, GUSAU

*Yields in lb. Threshed Grain per acre:
Stand Counts as Percentages of Maximum*

<i>Treatment</i>	<i>Grain</i>	<i>Per cent Stands</i>
	N.S.	N.A.
Control	1,189	95.4
Fernasan A 0.15 per cent	1,155	97.9
Fernasan D 0.3 per cent	1,160	99.5
Fernasan D 0.6 per cent	1,255	94.6
YF 4183	1,091	97.1
S.E.	±93	—

No significant results were obtained. Fernasan D 0.6 per cent tended to retard germination but this had no effect on subsequent yield. Yields overall were good.

4. *Benue Province—Yandev*.—This trial was conducted for the first year. The treatments were also applied to the interplanted millet crop but this failed to produce any yield due to drought. Yield and stand count figures for guineacorn are given in Table 45.

TABLE 45.—SEED DRESSING ON GUINEACORN, YANDEV

*Yields in lb. Threshed Grain per acre:
Stand Counts as Percentages of Maximum*

<i>Treatment</i>	<i>Grain</i>	<i>Per cent</i>	<i>Percent Stands</i>
		<i>Germina- tion</i>	<i>Harvest</i>
	N.S.	*	N.A.
Control	499	81.1	83.0
Fernasan A 0.15 per cent	495	88.9	90.9
Fernasan D 0.3 per cent	564	95.5	97.7
Fernasan D 0.6 per cent	601	92.2	94.3
YF 4183 0.2 per cent	617	92.2	94.3
S.E.	±79	±2.8	

The experiment showed a very low standard of precision (C.V.=37.7 per cent) otherwise the insecticide + fungicide treatments would most certainly have been significantly better than fungicide alone (Fernasan A) or control. The stand counts at harvest were not analysed but the germination percentages which were much the same, showed all dressed seed to have significantly more stands than control.

5. *General.*—A total of nine seed dressing trials on guineacorn have now been carried out at five stations over two years. Only one statistically significant result has been obtained to date in favour of seed dressings (at Samaru in 1956). A summary of the results for specific seed dressings is given in Table 46.

TABLE 46.—EFFECT OF SEED DRESSINGS ON GUINEACORN YIELDS
COMBINED RESULTS

Yields in lb. Threshed Grain per acre:

<i>Treatment</i>	<i>Number of Trials</i>	<i>Number of Seasons</i>	<i>Mean Yield</i>	<i>Increase over Control</i>
Control	9	2	926	
Fernasan A 0.15 per cent	9	2	1,019	+93
Fernasan D 0.2 per cent	2	1	1,184	+258
Fernasan D 0.3 per cent	8	2	960	+34
Fernasan D 0.4 per cent	1	1	622	+304
Fernasan D 0.6 per cent	5	1	1,105	+179
Copper carbonate 0.3 per cent	1	1	996	+70
YF 3670	2	1	1,070	+144
YF 3760	3	1	951	+25
YF 4183	5	1	1,035	+109
YF 4184	1	1	1,419	+493

The trend in favour of dressed seed over untreated seed is remarkably consistent.

COTTON

Most of the agronomic trials on cotton are covered in the Senior Cotton Breeder's report.

Fertiliser Trials

1. *Niger Province—Zuru.*—An N and P trial on cotton was carried out for the first time at Zuru. The results are given in Table 47,

TABLE 47.—NITROGEN AND PHOSPHATE ON COTTON, ZURU
Yields in lb. Seed Cotton per acre

Treatment											Seed Cotton
<i>Sulphate of Ammonia:</i>											N.A.
Nil	...	...	...	...	...	...	...	...	...	...	153
$\frac{1}{2}$ cwt per acre ...	...	...	...	...	...	...	...	...	...	...	150
<i>Superphosphate:</i>											
Nil	...	...	...	...	...	...	...	...	...	...	108
1 cwt per acre ...	...	...	...	...	...	...	...	...	...	...	195

NxP Interaction

											<i>Sulphate of Ammonia</i>	
<i>Superphosphate</i>											<i>Nil</i>	$\frac{1}{2}$ cwt
Nil	...	...	...	...	...	...	...	...	...	...	105	110
1 cwt	...	...	...	...	...	...	...	...	...	...	200	195

Due to low yields and insufficient replication, not much can be learned from this trial. The site selected was on very poor soil. There is an indication of a response to superphosphate; the response to sulphate of ammonia is virtually nil.

2. *Bauchi Province*.—Two trials were carried out at Sokwa and at Misau testing the effect of various levels of superphosphate on cotton yields. The results of the two trials are presented in Table 48.

TABLE 48.—SUPERPHOSPHATE ON COTTON, SOKWA AND MISAU
Yields in lb. Seed Cotton per acre

Treatment											Sokwa	Misau
<i>Superphosphate:</i>											***	N.S.
Nil	...	...	...	...	...	...	...	...	...	...	220	220
$\frac{1}{2}$ cwt per acre ...	...	...	...	...	...	...	...	...	...	...	300	230
1 cwt per acre ...	...	...	...	...	...	...	...	...	...	...	370	270
$1\frac{1}{2}$ cwt per acre ...	...	...	...	...	...	...	...	...	...	...	410	290
S.E.	...	...	...	...	...	...	...	...	...	...	±21	±21

At Misau yields were low and the response to superphosphate was slight and non-significant. At Sokwa the superphosphate at the three levels produced a straight line increase up to 1 cwt. per acre but fell off slightly at $1\frac{1}{2}$ cwt. The increases obtained (assuming superphosphate is 17s per $\frac{1}{2}$ cwt and that cotton is all Grade I at 6d per lb.) were economic at all levels.

Permanent D.N.P.K. Trials on Cotton

Two of the multifactorial trials designed to investigate the long term effects of repeated annual dressings of farmyard manure, sulphate of ammonia superphosphate and muriate of potash, have cotton as one of the crops in the rotation. The effect of these treatments on cotton is given in Table 49.

TABLE 49.—D.N.P.K. ON COTTON
Yields in lb. Seed Cotton per acre

Station							Daudawa	Samaru		
Number of years in which cotton has been test crop							6	3	Weighted Mean Yield	Increase over Nil.
<i>Farmyard Manure D</i>										
Nil	...	...	...	...	...	...	345	511	401	
1 ton per acre	...	...	...	...	...	...	404	603	470	+69
2 tons per acre	...	...	...	...	...	...	438	654	510	+109
<i>Sulphate of Ammonia N</i>										
Nil	...	...	...	...	...	...	353	554	420	
50 lb. per acre	...	...	...	...	...	...	420	606	482	+62
100 lb. per acre	...	...	...	...	...	...	414	607	478	+58
<i>Superphosphate P</i>										
Nil	...	...	...	...	...	...	374	553	434	
50 lb. per acre	...	...	...	...	...	...	394	583	457	+23
100 lb. per acre	...	...	...	...	...	...	418	633	490	+56
<i>Muriate of Potash K</i>										
Nil	...	...	...	...	...	...	387	583	452	
25 lb. per acre	...	...	...	...	...	...	396	605	466	+14
100 lb. per acre	...	...	...	...	...	...	405	581	463	+11
<i>Interactions (linear effect only)</i>										
DxN	...	...	...	...	...	...	—14	—78	—35	
DxP	...	...	...	...	...	...	—6	—39	—17	
DxK	...	...	...	...	...	...	—3	+29	+8	
NxP	...	...	...	...	...	...	—19	—23	—20	
NxK	...	...	...	...	...	...	+3	+37	+14	
PxK	...	...	...	...	...	...	—16	+8	—8	

As in the case of guineacorn the main response is to farmyard manure with 2 tons giving a reasonable increase over 1 ton.

Sulphate of ammonia shows an increase for 50 lb per acre almost equivalent to that for 1 ton of farmyard manure but there is no gain for the second 50 lb.

Superphosphate produces a much lower response than either farmyard manure or sulphate of ammonia, but the higher level has produced an appreciable increment over the lower level.

The effect of muriate of potash is slight and there is an indication that the higher level may actually tend to depress yields compared to the lower level.

The interactions are mainly negative but are not large. The only positive interactions are muriate of potash with farmyard manure and with sulphate of ammonia; however, these are small.

Cultural Trials on Cotton

Spacing of Cotton—Samaru.—An observation trial was carried out comparing different spacings of cotton at different fertility levels on flat beds. The results are given in Table 50.

TABLE 50.—SPACING OF COTTON ON FLAT BEDS, SAMARU
Yields in lb. Seed Cotton per acre

<i>Fertilisers per acre</i>	<i>Spacing</i>			<i>Mean for Fertiliser</i>
	12" x 12"	24" x 12"	24" x 18"	
Nil	369	367	391	376
1 cwt Superphosphate	406	409	317	377
2 cwt Superphosphate	304	551	237	364
1 cwt Super + 1 cwt S/A	470	438	351	420
1 cwt Super + 2 cwt S/A	440	443	375	419
2 cwt Super + 1 cwt S/A	337	415	388	380
2 cwt Super + 2 cwt S/A	403	339	283	342
Mean for Spacings	390	423	335	

Note: The trial was thinned to one plant per stand.

The plot sizes used for this trial were extremely small and as there was no replication, no real conclusion can be drawn. 12" x 12" and 24" x 12" spacings seem to be superior to 24" x 18" spacing. The response to fertiliser applications was negligible.

MILLET

Fertiliser Trials

1. *Plateau Province—Jema'a.*—This trial was carried out on late transplanted dauro which is a short season millet that is transplanted, usually after a crop of early groundnuts is harvested. The results are presented in Table 51.

TABLE 51.—NITROGEN AND PHOSPHATE ON TRANSPLANTED,
DAURO—JEMA'A
Yield in lb. Threshed Grain per acre

<i>Treatment</i>	1956	1955
	<i>Grain</i>	<i>Grain</i>
<i>Sulphate of Ammonia:</i>	***	***
Nil	839	613
$\frac{1}{2}$ cwt per acre	1,024	782
1 cwt per acre	1,120	885
<i>Superphosphate:</i>	**	N.S.
Nil	895	725
$\frac{1}{2}$ cwt per acre	997	774
1 cwt per acre	1,091	781
S.E.	±36	±26

In neither year was the N x P interaction significant. Yields are very good for transplanted dauro. The response to sulphate of ammonia is virtually the same as in 1955, except that this year the higher level just misses significance over the lower level.

The significant response to superphosphate is not as marked as the response to sulphate of ammonia.

2. *Sokoto Province—Kasarawa.*—An observation trial of sulphate of ammonia and superphosphate on millet was conducted for the second year at Sokoto. The results are given in Table 52.

TABLE 52.—NITROGEN AND PHOSPHATE ON MILLET, KASARAWA
Yields in lb. Threshed Grain per acre

<i>Superphosphate</i>	<i>Sulphate of Ammonia</i>					
	1956			1955		
	Nil	$\frac{1}{2}$ cwt	1 cwt	Nil	$\frac{1}{2}$ cwt	1 cwt
Nil	277	328	655	50	88	151
1 cwt	328	529	693	76	101	151
2 cwt	265	769	756	76	214	202

Yields were much higher this year. The response to sulphate of ammonia is quite marked and there is indication of a positive N x P interaction. The response to superphosphate alone is negligible.

3. *Zaria Province—Zonkwa.*—A trial has been carried out for two years applying superphosphate and sulphate of ammonia to early groundnuts and also testing the residual effects of these applications on late transplanted dauro. The results for the dauro are given in Table 5. N and P on early groundnuts followed by dauro. In both years the dauro showed a significant response to the superphosphate originally applied to the early groundnuts. There was no response to the sulphate of ammonia.

4. *Ilorin Province—Lafiagi.*—An N and P trial was carried out at Lafiagi on guineacorn interplanted with maiwa. Due to drought the maiwa was a complete failure. See Table 30 for the guineacorn results.

Permanent Manurial Trials on Millet

1. *Kano Province—Kano.*—The trial comparing continuous millet with and without manure that started in 1931 was concluded in 1956. The results for the twenty-six years are presented in Table 53.

The main points emerging from this long term trial is that millet appears to be capable of sustaining yields at a reasonable level for a considerable period despite low fertility levels and the effect of monoculture. Up to 1942 it appeared that monoculture was reducing yields on both the manured and unmanured treatments but this trend was reversed and yields on both treatments showed a general upward trend (with seasonal variations) up to 1956. The manured treatments showed a much greater ability to respond to favourable growing conditions than did the unmanured treatment. Regression coefficients were calculated for rain falling between 1st May and 31st July and yield for the manured and unmanured plots. This period was selected arbitrarily as only monthly rainfall figures are available for the earlier years of this trial.

Manured plots $b=1.247$	...	...	...	...	Not significant
Unmanured plots $b=1.192$	...	...	...	...	Not significant

The actual daily distribution of rainfall particularly at the beginning and end of the growing season for millet, is very important.

Fig. 3. Permanent Manurial Trial on Millet. Kano.

A ————— No manure.

B - - - - - 3 tons F.Y.M. per acre per annum.



TABLE 53.—PERMANENT MANURIAL TRIAL ON MILLET, KANO
Yields in lb. Threshed Grain per acre

Year				Treatment		Increase of B over A	S.E. ±	Significance
				A No manure	B 3 t.p.a. F.Y.M.			
1931	...	...	...	937	987	+50	72	} Not significant Significant
1932	...	...	...	790	1,034	+244	105	
1933	...	...	...	1,093	1,282	+189	149	
1934	...	...	...	820	1,114	+294	88	
1935	...	...	...	477	779	+302	47	
1936	...	...	...	493	789	+296	64	
1937	...	...	...	507	890	+383	86	
1938	...	...	...	384	697	+313	42	} Highly Significant
1939	...	...	...	359	649	+290	30	
1940	...	...	...	291	709	+418	50	
1941	...	...	...	156	468	+312	34	
1942	...	...	...	107	232	+125	21	
1943	...	...	...	386	880	+494	70	
1944	...	...	...	437	667	+230	45		} Not Significant
1945	...	...	...	337	688	+351	37	
1946	...	...	...	495	876	+381	182	
1947	...	...	...	479	727	+248	31	
1948	...	...	...	359	691	+332	48	
1949	...	...	...	544	1,053	+509	79	
1950	...	...	...	560	1,355	+795	213	} Highly Significant
1951	...	...	...	374	873	+499	35	
1952	...	...	...	198	732	+534	39	
1953	...	...	...	207	752	+545	43	
1954	...	...	...	252	786	+534	30	
1955	...	...	...	444	715	+271	34	
1956	...	...	...	447	1,163	+716	65	

Seed Dressing Trials on Millet

The effect of various proprietary seeds dressing compound on millet germination and yield were tested at five stations.

1. *Samaru*.—The results for 1955 and 1956 are given in Table 54.

TABLE 54.—SEED DRESSINGS ON MILLET, SAMARU
Yields in lb. Threshed Grain per acre:
Stand Gounts at Germination as Percentages of Maximum

<i>Treatment</i>	1956		1955	
	<i>Grain</i>	<i>Per cent Stands</i>	<i>Grain</i>	<i>Per cent Stands</i>
Control	***		N.S.	
Fernasan A 0.15 per cent	617	80.9	857	95.6
Fernasan D 0.2 per cent	715	94.5	834	98.0
Fernasan D 0.3 per cent	827	100.0	—	—
Fernasan D 0.6 per cent	833	99.9	838	99.7
YF 2670 0.2 per cent	823	99.9	—	—
YF 3760 0.3 per cent	—	—	854	99.5
YF 4184 0.2 per cent	—	—	851	99.3
YF 4183 0.2 per cent	821	100.0	—	—
YF 4183 0.2 per cent	827	99.9	—	—
S.E.	±32	—	±23	—

The insecticide + fungicide dressings, Fernasan D and YF 4183 and YF 4184 have all given significant increases in yield over the fungicide dressing, Fernasan A, and Control. Fernasan A is also significantly better than control. The superiority of the insecticide + fungicide dressings which all gave virtually identical yields was due to higher stand counts (practically 100 per cent in each case). The correlation coefficient between between stand count and yield ($r = +0.766$) was highly significant. Stand counts on the Fernasan A and control plots were reduced by an attack of larvae of a melolonthid beetle. The effect of these and of unknown soil fungi on stands is shown in Table 55.

It will be seen that the control and Fernasan A plots germinated as well as the other treatments but that considerable reduction in stands took place a fortnight after planting. The insecticide content of the seed dressings even at the extremely low concentrations used obviously protected the seedlings. As Fernasan A was not nearly as badly affected as control, the fungicide was apparently controlling some soil organisms.

TABLE 55.—SEED DRESSINGS ON MILLET—STAND COUNT DATA, SAMARU
Stand Counts as Percentages of Maximum

<i>Treatment</i>	<i>Number of Days after Planting</i>					
	4	6	13	15	18	89
Control	98.6	98.8	85.7	80.9	79.1	75.4
Fernasan A 0.15 per cent ...	99.7	100.0	96.2	94.5	91.7	89.5
Fernasan D 0.2 per cent ...	100.0	100.0	100.0	100.0	100.0	99.8
Fernasan D 0.3 per cent ...	99.9	99.9	100.0	100.0	100.0	99.5
Fernasan D 0.6 per cent ...	99.4	100.0	99.9	99.9	99.9	99.6
YF 4183	99.5	100.0	99.9	99.9	99.9	99.6
YF 4184	100.0	100.0	100.0	100.0	100.0	100.0

Yields of millet would have been higher except for attacks of ergot (*Sphacelia* sp.), smut (*Tolyposporium penicillariae*), mould (*Tricothecum* sp.) and grain moth (not identified). None of the diseases mentioned are seed borne and therefore are not controllable by seed dressings.

2. *Kano Province -Kano.*—The results for 1955 and 1956 are given in Table 56.

TABLE 56.—SEED DRESSINGS ON MILLET, KANO
Yields in lb. Threshed Grain per acre:
Stand Counts at Germination as Percentage of Maximum

Treatment	1956		1955	
	Grain	Per cent Stands	Grain	Per cent Stands
	N.S.		*	
Control	977	93.8	594	99.4
Fernasan A 0.15 per cent	989	95.6	699	97.8
Fernasan D 0.3 per cent	1,041	96.3	809	98.9
Fernasan D 0.6 per cent	1,077	96.9	—	—
YF 3670	—	—	645	99.2
YF 3760	—	—	691	98.9
YF 4183	1,059	96.3	—	—
S.E.	±56		±42	—

Although no significant results were obtained this year, there is a trend in favour of the insecticide — fungicide treatments compared to fungicide alone (Fernasan A) and the untreated control.

Growing conditions were very good for this crop of millet and yields were above average.

3. *Sokoto Province -(a) Kasarawa.*—The results for 1955 and 1956 are given in Table 57.

TABLE 57.—SEED DRESSINGS ON MILLET, KASARAWA
Yield in lb. Threshed Grain per acre:
Stand Counts at Germination as Percentage of Maximum

Treatment	1956		1955	
	Grain	Per cent Stands	Grain	Per cent Stands
	N.S.		*	
Control	543	90.8	283	60.4
Fernasan A 0.15 per cent	583	93.3	579	85.2
Fernasan D 0.3 per cent	672	95.0	510	87.1
Fernasan D 0.4 per cent	—	—	618	89.1
Fernasan D 0.6 per cent	695	96.7	—	—
YF 3760	—	—	544	90.6
YF 4183	637	95.8	—	—
S.E.	±54	—	±71	—

There is a trend in favour of the insecticide + fungicide seed dressings over the fungicide alone and control but it is not significant.

Yields are about average for Kasarawa.

(b) *Gusau*.—This was the first year of this trial. The results are presented in Table 58.

TABLE 58.—SEED DRESSINGS ON MILLET, GUSAU
Yields in lb. Threshed Grain per acre:
Stand Counts at Germination as Percentages of Maximum

<i>Treatment</i>										<i>Grain</i>	<i>Per cent Stands</i>
										N.S.	
Control	...	...	...	...	...	...	...	...	...	800	97.6
Fernasan A 0.15 per cent	...	...	...	...	...	...	...	...	...	807	99.1
Fernasan D 0.3 per cent	...	...	...	...	...	...	...	...	...	782	97.9
Fernasan D 0.6 per cent	...	...	...	...	...	...	...	...	...	801	98.1
YF 4183	...	...	...	...	...	...	...	...	...	859	99.3
S.E.	...	...	...	...	...	...	...	...	...	±37	

No significant results were obtained and there is no indication of a trend in favour of seed dressings. Growing conditions were quite good and yields were satisfactory.

4. *Benue Province—Yandev*.—A trial was conducted for the first year at Yandev on seed dressings on guineacorn interplanted with millet. The results for the guineacorn are given in Table 45. The millet crop failed due to drought; the germination figures are given in Table 59.

TABLE 59.—SEED DRESSINGS ON MILLET, YANDEV
Germination Counts as Percentages of Maximum

<i>Treatment</i>										<i>Percentage Stands</i>
										N.A.
Control	...	...	...	...	...	...	...	...	...	43.2
Fernasan A 0.15 per cent	...	...	...	...	...	...	...	...	...	61.9
Fernasan D 0.3 „	...	...	...	...	...	...	...	...	...	79.6
Fernasan D 0.6 „	...	...	...	...	...	...	...	...	...	77.3
YF 4183	...	...	...	...	...	...	...	...	...	84.7

The treated seed germinated much better than the untreated control. The insecticide + fungicide dressings were better than fungicide alone.

5. *General*.—A total of eight seed dressing trials on millet have now been carried out at five stations over two seasons. One of these trials failed due to drought; three of the trials produced significant increases in yield due to the use of seed dressings. A summary of the results is given in Table 60.

TABLE 60.—EFFECT OF SEED DRESSINGS ON MILLET YIELDS
Combined results—Yields in lb. Threshed Grain per acre

Treatment							Number of Trials	Number of Seasons	Mean Yield	Increase over Control
Control	...	...	...	...	...	...	7	2	667	
ernasan A	0.15	per cent	...	...	...	...	7	2	744	+77
ernasan D	0.2	"	...	...	...	...	1	1	827	+160
ernasan D	0.3	"	...	...	...	...	7	2	784	+117
ernasan D	0.4	"	...	...	...	...	1	1	618	—49
ernasan D	0.6	"	...	...	...	...	4	1	849	+182
F 3670	...	...	...	...	...	...	2	1	750	+83
F 3760	...	...	...	...	...	...	3	1	695	+28
F 4183	...	...	...	...	...	...	4	1	846	+179
F 4184	...	...	...	...	...	...	1	1	821	+154

In general there has been a response to almost all the seed dressings which is even more marked than in the case of guineacorn (when the generally lower yields of millet are taken into consideration). This is probably due to the fact that millet is normally the first crop to be planted in most far northern areas and as such tends to experience more adverse growing conditions than either guineacorn or groundnuts, due to erratic early rains.

YAMS *Fertiliser Trials*

1. *Ilorin Province*.—Five trials of sulphate of ammonia and superphosphate on yams were carried out at new sites in Ilorin Province. The results are presented in Table 61.

TABLE 61.—NITROGEN AND PHOSPHATE ON YAMS, ILORIN DIVISION
Yields in cwt Tubers per acre

Treatment							Paiye		Oke-Ode		Omu-Aran
<i>Sulphate of Ammonia:</i>							***	N.S.	***	***	***
il	...	...	...	...	...	...	72.4	93.2	53.6	43.2	93.55
cwt per acre	...	...	...	...	...	...	112.3	102.8	68.8	56.1	120.4
cwt	...	...	...	...	...	...	119.4	110.5	85.5	64.0	120.0
<i>Superphosphate:</i>							N.S.	N.S.	N.S.	N.S.	*
il	...	...	...	...	...	...	102.1	94.4	66.8	54.0	104.4
cwt per acre	...	...	...	...	...	...	97.9	108.0	70.1	54.8	114.9
cwt.	...	...	...	...	...	...	104.2	104.1	71.0	54.6	114.6
S.E.	...	...	...	...	...	...	±4.2	±5.4	±3.7	±2.2	±3.15
<i>NxP Interaction</i>							N.S.	N.S.	N.S.	N.S.	N.S.

The results for four of the experiments are extremely consistent; the response is almost entirely to sulphate of ammonia which has usually been the case on yam experiments. Yams were worth £18 per ton in Ilorin in December, 1956 and sulphate of ammonia cost £2-2s-0d per cwt; at these

rates all increases in yield from application of 1 cwt of sulphate of ammonia are economic.

The interaction of the five experiments combined is not significant. It is, however, positive and strongly suggests that sulphate of ammonia is more effective in the presence of superphosphate than in its absence. N1P1 gave an increased yield of 10 cwt over N1P0 and N2P1 an increase of 6 cwt over N2P0. The increases with the higher level of P were the same as with the lower. Similar results have been obtained in previous years in this area. Table 62 shows the combined yields.

TABLE 62.—N AND P ON YAMS, ILORIN PROVINCE
Combined yields in cwt. Tubers per acre

<i>Sulphate of Ammonia</i>								<i>Superphosphate</i>		
								<i>Nil</i> <i>p0</i>	$\frac{1}{2}$ <i>cwt</i> <i>p1</i>	<i>1 cwt</i> <i>p2</i>
Nil	...	...	...	...	...	...	n0	71.8	70.7	71.2
1 cwt	...	...	...	...	...	...	n1	85.8	95.4	95.1
2 cwt	...	...	...	...	...	...	n2	95.5	101.3	102.9

2. *Kabba Province*—(a) *Osara*.—An N and P trial on yams was carried out for the second year at Osara Farm. The results are given in Table 63.

TABLE 63.—NITROGEN AND PHOSPHATE ON YAMS, OSARA
Yields in cwt. Yam Tubers per acre

<i>Treatment</i>										1956	1955
<i>Sulphate of Ammonia:</i>										<i>N.S.</i>	<i>***</i>
Nil	...	...	...	...	...	...	...	...	...	101.4	36.1
1 cwt per acre	...	...	...	...	...	...	...	...	...	103.0	57.1
2 cwt	...	...	...	...	...	...	...	...	...	95.4	51.4
S.E.	...	...	...	...	...	...	...	...	...	±3.82	±2.90
<i>Superphosphate:</i>										<i>N.S.</i>	<i>**</i>
Nil	...	...	...	...	...	...	...	...	...	98.0	41.9
1 cwt per acre	...	...	...	...	...	...	...	...	...	101.9	54.6
S.E.	...	...	...	...	...	...	...	...	...	±3.13	±2.37
<i>NxP Interaction</i>										<i>N.S.</i>	<i>N.S.</i>

There were no significant results in 1956; yields were very much higher than in 1955.

(b) *Dekina*.—Following an observation trial in 1955 which showed marked responses to sulphate of ammonia, a formal N and P trial was carried out in 1956. The results are given in Table 64.

TABLE 64.—NITROGEN AND PHOSPHATE ON YAMS, DEKINA
Yields in cwt. Yam Tubers per acre

<i>Treatment</i>	<i>Tubers</i>
<i>Sulphate of Ammonia:</i>	***
Nil	71
1 cwt per acre	90
2 cwt „	106
<i>Supersphosphate:</i>	N.S.
Nil	89
1 cwt per acre	91
2 cwt „	87
S.E.	±4
NxP Interaction	N.S.

The only response was to sulphate of ammonia, both levels being significantly better than nil; there was also a significant difference between the two levels.

3. *Benue Province*—(a) *Mbatie*.—In 1953 an N.P.K. trial on yams was started at Mbatie; no significant results were obtained in that year.

In 1954 1 and 2 cwt of sulphate of ammonia were significantly better than nil; 2 cwt was better than 1 cwt.

In 1955 the same results were obtained as in 1954. In no year did muriate of potash produce any effect. Because of these results potash, in 1956, was dropped from the experiment which became a straight N and P trial. No significant results were obtained for either main effects or interactions. The results are given in Table 65.

TABLE 65.—NITROGEN AND PHOSPHATE ON YAMS, MBATIE
Yields in cwt. Yam Tubers per acre

<i>Treatment</i>	1956	1955	1954	1953
<i>Sulphate of Ammonia:</i>	N.S.	***	***	N.S.
Nil	81.4	87.0	90.0	61.4
1 cwt per acre	80.1	111.5	126.0	67.4
2 cwt „	82.5	128.0	143.1	67.4
3 cwt „	84.8	—	—	—
<i>Superphosphate:</i>	N.S.	N.S.	N.S.	N.S.
Nil	79.4	107.5	128.8	56.9
1 cwt per acre	86.6	112.9	116.1	64.0
2 cwt „	83.2	106.1	115.0	68.8
2½ cwt „	79.6	—	—	—
<i>Muriate of Potash:</i>	—	N.S.	N.S.	N.S.
Nil	—	109.5	124.3	65.3
46 lb. per acre	—	106.9	116.1	65.2
92 lb. „	—	110.2	119.5	59.3
S.E.	±2.74	±2.96	±4.74	±3.73

Drought during 1956 might have been responsible for the lower yields and the lack of response to sulphate of ammonia.

(b) *Idoma Division*.—A trial has been carried out for two years in Idoma comparing the effect of various N.P.K. mixtures on yams. The soils of this area are similar to the sands found in the Nsukka area of the Eastern Region where an N.P.K. mixture has been recommended. The results for 1955 and 1956 are given in Table 66.

TABLE 66.—N.P.K. ON YAMS, IDOMA DIVISION
Yields in cwt. Tubers per acre

<i>Treatment</i>	1956	1955
	<i>N.S.</i>	<i>N.S.</i>
Nil	52.9	38.4
1 cwt N+1 cwt P+ $\frac{1}{2}$ cwt K	77.2	51.1
1 cwt N+1 cwt P+ $\frac{1}{4}$ cwt K	71.9	43.0
1 $\frac{1}{2}$ cwt N+1 cwt P+ $\frac{1}{2}$ cwt K	78.5	37.8
1 $\frac{1}{2}$ cwt N+1 cwt P+ $\frac{3}{4}$ cwt K	71.4	50.5
S.E.	± 6.54	± 5.50

Note.—N=Sulphate of ammonia

P=Superphosphate

K=Muriate of potash.

No significant results were obtained in either year. Examination of the 1956 results showed that a comparison of fertilisers versus nil gave a significant increase in yield.

4. *Plateau Province*—(a) *Riyom*.—An N.P.K. trial on yams was carried out for the first time at Riyom. The results are given in Table 67.

TABLE 67.—N.P.K. ON YAMS, RIYOM
Yields in cwt. Tubers per acre

<i>Treatment</i>	<i>Tubers</i>
<i>Sulphate of Ammonia</i> N	<i>N.S.</i>
Nil n0	32.1
1 cwt per acre n1	31.8
2 cwt " n2	35.3
<i>Superphosphate</i> P	<i>N.S.</i>
Nil p0	31.6
1 cwt per acre p1	33.6
2 cwt " p2	34.2
<i>Muriate of Potash</i> K	<i>N.S.</i>
Nil k0	32.6
$\frac{1}{2}$ cwt per acre k1	32.8
1 cwt " k2	34.0
S.E.	± 1.31

TABLE 67—*continued**Interactions*

			<i>N</i> × <i>P</i>		<i>N.S.</i>	
			<i>n</i> 0	<i>n</i> 1	<i>n</i> 2	
<i>p</i> 0	...	...	34.0	27.0	33.7	
<i>p</i> 1	...	...	31.1	36.0	33.8	
<i>p</i> 2	...	...	31.3	32.2	39.1	

S.E. = ±2.27

			<i>P</i> x <i>K</i>			*				<i>N</i> x <i>K</i>	*
			<i>n</i> 0	<i>n</i> 1	<i>n</i> 2				<i>p</i> 0	<i>p</i> 1	<i>p</i> 2
<i>k</i> 0	...	...	31.7	31.3	34.8	<i>k</i> 0	...	...	29.6	34.9	33.2
<i>k</i> 1	...	...	32.5	36.8	29.2	<i>k</i> 1	...	...	31.1	37.3	30.1
<i>k</i> 2	...	...	32.1	27.2	42.7	<i>k</i> 2	...	...	34.0	28.8	39.2
S.E.= ±2.27						S.E.= ±2.27					

S.E. = ±2.27

S.E. = ±2.27

The effects of *N*, *P* and *K* singly were not significant but the interactions *N* × *K* and *P* × *K* were significant (*P* = .05). Only one replication of this trial could be planted due to lack of seed and as a result the second order interaction had to be used as an estimate of error and could not be examined statistically. Examination of individual plot yields showed the highest yields on plots receiving the *N.P.K.* mixtures.

Permanent D.N.P.K. Trials on Yams

1. *Benue Province—Yandev.*—One of the multifactorial *D.N.P.K.* trials has yams interplanted with cowpeas as one of the courses of the rotation. The results for yams are given in Table 68.

Farmyard manure at 1 ton per acre produces a response which is almost doubled when the level is increased to 2 tons.

Sulphate of ammonia produces a substantial response at 50 lb. per acre; there is a further small increase when the level is increased to 100 lb.

Superphosphate produces a fair response at 50 lb per acre but there is a small decline in response at the higher level of 100 lb. Muriate of potash produces virtually no effect at the lower rate but there is a definite decline in yield at 50 lb per acre. The only positive interactions were for *N* × *P* and *P* × *K* but these are not large. The largest negative interactions are *D* × *N* and *D* × *K*, both of which are consistent.

TABLE 68.—D.N.P.K. ON YAMS, YANDEV

Yields in cwt. Tubers per acre

<i>Treatment</i>						1950	1953	1956	Mean	Increase over Nil
<i>Farmyard Manure D</i>						N.S.	**	***		
Nil	...	...	...	...	...	125.5	108.4	79.1	104.3	
1 ton per acre	...	...	...	...	...	131.3	111.7	86.9	110.0	+5.7
2 tons	...	...	...	...	...	132.2	119.0	93.6	114.9	+10.6
<i>Sulphate of Ammonia N</i>						**	***	*		
Nil	...	...	...	...	...	123.2	105.0	80.6	102.9	
50 lb. per acre	...	...	...	...	...	130.5	117.2	88.4	112.0	+9.1
100 lb. per acre	...	...	...	...	...	135.2	116.9	90.6	114.2	+11.3
<i>Superphosphate P</i>						*	**	N.S.		
Nil	...	...	...	...	...	126.0	108.1	83.7	105.9	
50 lb. per acre	...	...	...	...	...	128.6	120.0	89.6	112.7	+6.7
100 lb. "	...	...	...	...	...	134.4	111.1	86.3	110.6	+4.7
<i>Muriate of Potash K</i>						N.S.	***	N.S.		
Nil	...	...	...	...	...	127.3	119.2	87.4	113.3	
25 lb. per acre	...	...	...	...	...	133.1	114.1	89.6	112.3	+1.0
50 lb. "	...	...	...	...	...	128.6	105.7	82.5	105.6	-5.7
S.E.	...	...	...	...	...	±2.4	±2.3	±2.4		
<i>Interactions (Linear effect only)</i>										
	DxN	...	...	...	...	-6.1	-6.1	-9.4	-7.2	
	DxP	...	...	...	...	+2.0	-0.3	-8.2	-2.2	
	DxK	...	...	...	...	-3.7	-5.5	-5.8	-5.0	
	NxP	...	...	...	...	+7.8	-3.3	+6.6	+3.7	
	NxK	...	...	...	...	-2.7	+2.2	+0.7	+0.1	
	PxK	...	...	...	...	+0.9	+4.1	+6.9	+4.0	
S.E.	...	...	...	...	...	±4.15	±3.96	±4.16		

Yam Beetle Trials

Yam beetle, *Heteroligus* sp., is a serious pest of yams in parts of the Middle Belt and trials have been initiated at several stations to investigate the feasibility of chemical control.

1. *Plateau Province—Lowlands Farm.*—A trial was carried out comparing several insecticides as a method of controlling yam beetle attack on Lowlands Farm which is an area liable to severe attack. The technique used for application consists simply of rolling the yam 'seed' in the insecticidal dust and then planting in the usual way. The results are presented in Table 69.

TABLE 69.—INSECTICIDE CONTROL OF YAM BEETLE, LOWLANDS

*Yields in cwt. Tubers per acre:**Plants attacked by Beetles as percentages*

<i>Treatment</i>	<i>Tubers</i>	<i>Percentage Attack</i>
Control	106.9	N.S.
Agroicide 7	122.1	95.6
Gammalin 2	78.9	83.4
2.6 per cent B.H.C.	114.6	90.1
0.9 per cent D.D.T.	110.7	78.9
S.E.	±8.92	88.8
		±14.0

All treatments gave higher yield than control apart from Gammalin which was significantly lower yielding than all treatments. Yield figures however give no indication of the marketability of the yams. Scoring for marketability showed that 2.6 per cent B.H.C., and Agroicide 7 produces the highest proportion of marketable yams.

Palatability trials gave no indications of tainting.

The results of this trial indicate that insecticide dusts may give a certain degree of control against yam beetle attack but further investigation is required.

2. *Niger Province—Mokwa.*—A trial similar to that at Lowlands Farm was carried out at Mokwa but failed due to poor seed and late planting.

3. *General.*—It would appear that yam beetle attack is more severe on the lighter sandy soils which are reasonably free draining than on heavier wetter soils.

CASSAVA

Fertiliser Trials

1. *Kano Province—Kano.*—A permanent D.N.P., trial has been carried out on short-season (10-12 months) cassava at Kano since 1953. The results to date are presented in Table 70.

TABLE 70.—D.N.P. ON CASSAVA, KANO
Yields in cwt. Roots per acre

<i>Treatment</i>	1956	1955	1954	1953
<i>Farmyard Manure:</i>	<i>N.A.</i>	<i>N.S.</i>	<i>N.S.</i>	<i>N.S.</i>
Nil	30.6	64.3	90.8	60.6
1 ton per acre	44.4	71.7	92.3	62.0
2 tons per acre	53.5	74.1	96.5	69.8
<i>Sulphate of Ammonia:</i>		*	*	***
Nil	34.7	50.5	66.4	48.3
$\frac{1}{2}$ cwt per acre	46.6	77.6	92.6	65.6
1 cwt per acre	47.2	82.0	120.5	79.5
<i>Superphosphate:</i>		<i>N.S.</i>	<i>N.S.</i>	<i>N.S.</i>
Nil	40.5	77.7	96.9	65.9
$\frac{1}{2}$ cwt per acre	43.3	77.6	95.7	62.6
1 cwt per acre	44.8	54.8	87.0	64.0
S.E.	—	±7.3	±10.01	±4.28

The trial this year was too severely affected by waterlogging to justify statistical analysis.

2. *Benue Province—Mbatie.*—An N.P.K., trial on short-season cassava has completed two seasons at Mbatie. The results are given in Table 71.

TABLE 71.—N.P.K. ON CASSAVA, MBATIE
Yields in cwt. Roots per acre

<i>Treatment</i>	1956	1955
<i>Sulphate of Ammonia:</i>	<i>N.S.</i>	<i>N.S.</i>
Nil	62.7	69.3
1 cwt per acre	69.6	71.0
2 cwt per acre	62.0	77.6
<i>Superphosphate:</i>	<i>N.S.</i>	<i>N.S.</i>
Nil	64.4	67.4
$\frac{1}{2}$ cwt per acre	64.4	75.6
1 cwt per acre	65.5	74.9
<i>Muriate of Potash:</i>	<i>N.S.</i>	<i>N.S.</i>
Nil	64.0	78.3
$\frac{1}{4}$ cwt per acre	64.6	70.5
$\frac{1}{2}$ cwt per acre	65.6	69.1
S.E.	±3.6	±4.4

None of the interactions was significant in either year; the C.V. was high in both years, 24 per cent in 1956 and 26 per cent in 1955.

Once again no significant results were obtained; no obvious trends emerge from the results.

3. *Ilorin Province—Ilorin.*—The first results from an N.P.K. trial on long-season (two years) cassava are presented in Table 72.

TABLE 72.—N.P.K. ON CASSAVA, ILORIN

Yields in cwt. Roots per acre

<i>Treatment</i>											<i>Cassava Roots</i>
<i>Sulphate of Ammonia:</i>											*
Nil	...	...	...	...	...	...	...	...	...	...	93.2
$\frac{1}{2}$ cwt per acre	...	...	...	...	...	...	...	...	...	...	86.8
1 cwt per acre	...	...	...	...	...	...	...	...	...	...	110.0
<i>Superphosphate:</i>											N.S.
Nil	...	...	...	...	...	...	...	...	...	...	89.6
$\frac{1}{2}$ cwt per acre	...	...	...	...	...	...	...	...	...	...	88.2
1 cwt per acre	...	...	...	...	...	...	...	...	...	...	99.3
<i>Muriate of Potash:</i>											N.S.
Nil	...	...	...	...	...	...	...	...	...	...	93.2
$\frac{1}{2}$ cwt per acre	...	...	...	...	...	...	...	...	...	...	86.8
$\frac{1}{2}$ cwt per acre	...	...	...	...	...	...	...	...	...	...	97.0
S.E.	...	...	...	...	...	...	...	...	...	...	± 7.77

Sulphate of ammonia produced the only significant increase in yield, 1 cwt per acre being significantly better than nil. None of the interactions was significant.

The growing season for cassava in Ilorin is almost two years; this trial was planted in June, 1955 and harvested in May, 1957; fertilisers were applied in July, 1955, no application being made in 1956.

Permanent D.N.P.K. Trials on Cassava

Niger Province—Bida.—The multifactorial D.N.P.K. trial at Bida has short-season cassava as one of the courses of the rotation.

The results for two years are given in Table 73.

TABLE 73.—D.N.P.K. ON CASSAVA, BIDA
Yields of Roots in cwt. per acre

Treatment							1952	1955	Mean	Increase over Nil
<i>Farmyard Manure: D</i>							***	***		
Nil	...	...	...	...	...	...	41.8	32.8	37.3	
1 ton per acre	...	...	...	...	...	...	58.3	47.5	52.9	+15.6
2 tons per acre	...	...	...	...	...	...	68.6	55.1	61.9	+24.6
<i>Sulphate of Ammonia: N</i>							**	***		
Nil	...	...	...	...	...	...	49.4	39.0	44.2	
50 lb. per acre	...	...	...	...	...	...	58.6	46.6	52.6	+8.4
100 lb. per acre	...	...	...	...	...	...	60.8	49.7	55.3	+11.1
<i>Superphosphate: P</i>							N.S.	***		
Nil	...	...	...	...	...	...	51.6	42.2	46.9	
50 lb. per acre	...	...	...	...	...	...	58.2	54.1	51.7	+4.8
100 lb. per acre	...	...	...	...	...	...	58.9	48.1	53.5	+6.6
<i>Muriate of Potash: K</i>							N.S.	N.S.		
Nil	...	...	...	...	...	...	56.9	44.2	50.6	
25 lb. per acre	...	...	...	...	...	...	57.5	45.8	51.7	+1.1
50 lb. per acre	...	...	...	...	...	...	54.3	45.3	49.8	—0.8
S.E.	...	...	...	...	...	...	±2.43	±1.04		
<i>Interactions (linear effect only)</i>										
DxN	...	...	...	...	...	...	—8.39	—4.25	—6.32	
DxP	...	...	...	...	...	...	—8.27	—3.14	—5.71	
DxK	...	...	...	...	...	...	+2.46	—3.38	—0.46	
NxP	...	...	...	...	...	...	+3.03	+0.71	+1.87	
NxK	...	...	...	...	...	...	—1.45	+0.98	—0.24	
PxK	...	...	...	...	...	...	+0.36	—0.55	—0.10	
S.E.	...	...	...	...	...	...	±4.20	±1.79		

Farmyard manure has produced by far the largest response, 1 ton giving an increase of 42 per cent over nil and 2 tons 66 per cent over nil.

The effect of sulphate of ammonia has been to produce increases at both levels, 19 per cent for 50 lb, and 25 per cent for 100 lb.

Superphosphate has also produced increases at both levels; 10 per cent for 50 lb, and 14 per cent for 100 lb.

The effect of muriate of potash is negligible.

The D x N and D x P interactions are substantially negative. The only positive interaction is N x P but the effect is small. The other interaction effects are negative but are very low.

SOYA BEANS

Fertiliser Trials on Soya Beans

Three trials of Nitrogen and Phosphate on soya beans were carried out for the first time at three sites in the Middle Belt where soya beans are increasing in importance. The results are presented in Table 74 and 75.

TABLE 74.—NITROGEN AND PHOSPHATE ON SOYA BEANS, Omu-ARAN
(ILORIN PROVINCE) AND MBATIE (BENUE PROVINCE)
Yields in lb. Threshed Beans per acre

Treatment											Omu-Aran	Mbatie
<i>Sulphate of Ammonia:</i>											N.S.	N.S.
Nil	...	...	...	...	...	...	...	...	...	...	230	188
$\frac{1}{2}$ cwt per acre	...	...	...	...	...	...	...	...	...	...	215	182
S.E.	...	...	...	...	...	...	...	...	...	...	± 23	± 13
<i>Superphosphate:</i>											N.S.	N.S.
Nil	...	...	...	...	...	...	...	...	...	...	171	191
$\frac{1}{2}$ cwt per acre	...	...	...	...	...	...	...	...	...	...	240	175
1 cwt per acre	...	...	...	...	...	...	...	...	...	...	255	187
S.E.	...	...	...	...	...	...	...	...	...	...	± 25	± 16
<i>NxP Interaction</i>											N.S.	N.S.

No significant result was obtained at either station; yields were very low due to the abnormal drought during the middle of the rains.

TABLE 75.—NITROGEN AND PHOSPHATE ON SOYA BEANS, ABUJA
(NIGER PROVINCE)
Yields in lb. Threshed Beans per acre

Treatment											Seed
<i>Sulphate of Ammonia:</i>											*
Nil	...	...	...	...	...	...	...	...	...	...	897
$\frac{1}{2}$ cwt per acre	n1	...	...	...	...	...	...	...	...	...	982
1 cwt per acre	n2	...	...	...	...	...	...	...	...	...	958
<i>Superphosphate:</i>											**
Nil	p0	...	...	...	...	...	...	...	...	...	878
$\frac{1}{2}$ cwt per acre	p1	...	...	...	...	...	...	...	...	...	982
1 cwt per acre	p2	...	...	...	...	...	...	...	...	...	978
S.E.	...	...	...	...	...	...	...	...	...	...	± 23
<i>NxP Interaction</i>											***

	n0	n1	n2
p0	687	976	971
p1	1,013	947	987
p2	991	1,024	918

S.E. = ± 39

Yields in this trial were good. The interesting point emerging from these results is that each fertiliser alone is as good as the other or any combination of both.

Cultural Trials on Soya Beans: Spacing

Ilorin Province—Ilorin.—A trial was carried out at Ilorin comparing different spacings of soya beans. The results are presented in Table 76.

TABLE 76.—SPACING OF SOYA BEANS, ILORIN
Yields in lb. Threshed Beans per acre

<i>Distance between Stands</i>									<i>Distance between Ridges</i>		<i>Mean for Stands</i>
									<i>2 feet</i>	<i>3 feet</i>	
6 inches	...	...	...	...	...	...	...	...	593	528	561
9 inches	...	...	...	...	...	...	...	...	512	421	467
12 inches	...	...	...	...	...	...	...	...	544	405	475
18 inches	...	...	...	...	...	...	...	...	391	306	349
Mean for Ridges	...	...	...	...	...	...	...	...	510	415	—

S.E. of the body of the table = $\pm 52^*$

The closer spacings gave higher yields than the wider spacings, but given equal plant populations the width of ridge seems unimportant. Work on spacing of soya beans in other countries suggests that even closer spacing than those used in this trial would give even greater increases in yield. Yields in general were below average due to drought.

Benue Province—Yandev.—An observation trial comparing various spacings of soya beans planted on the ridge and on the flat was an almost complete failure due to drought. The yields obtained showed that the close spacings (4'' x 28'') gave higher yields than any of the wider spacings tried and that planting on the ridge was generally superior to planting on the flat.

COWPEAS

Spacing of Cowpeas

1. *Benue Province—Yandev.*—A spacing trial was superimposed on a cowpea variety trial at Yandev. The cowpeas were interplanted through yams at 16'' and 24'' spacing on 4-foot ridges. The results for three years are given in Table 77.

TABLE 77.—COWPEA VARIETY AND SPACING TRIAL, YANDEV
Yields in lb. Threshed Peas per acre

Treatment										1956	1955	1954
<i>Variety</i>										***	***	N.S.
Mauritius	...	...	...	...	...	...	...	...	...	97	211	293
New Era	...	...	...	...	...	...	...	...	...	56	201	233
Local	...	...	...	...	...	...	...	...	...	50	101	247
S.E.	...	...	...	...	...	...	...	...	...	±7	±14	±18
<i>Spacing</i>										***	N.S.	N.S.
Close	...	...	...	...	...	...	...	...	...	84	182	257
Wide	...	...	...	...	...	...	...	...	...	51	160	259
S.E.	...	...	...	...	...	...	...	...	...	±6	±11	±15
<i>Variety x Spacing</i>										N.S.	N.S.	*

Yields were exceptionally low due to drought; the C.V. was 35 per cent. For the first time close spacing was significantly better than wide spacing but this may be purely due to seasonal effects.

The interaction between varieties and spacing has only been significant in one year, 1954, when Mauritius was significantly better at close spacing than at wide spacing or the other varieties at any spacing. This trend also appeared in 1956 but was not significant.

2. *Katsina Province—Kafinsoli*.—A spacing trial was superimposed on a cowpea variety trial at Kafinsoli. Varieties of cowpeas interplanted with millet were grown at 3 feet and 1½ feet spacing on 3-foot ridges. Mistakes were made in laying down this trial and the results from only two blocks could be examined. The results are given in Table 78.

This year there was a marked trend in favour of close spacing. Mauritius and Local appeared to favour close spacing while New Era seemed to be little affected.

TABLE 78.—COWPEA VARIETY AND SPACING TRIAL, KAFINSOLI
Yields in lb. Threshed Peas per acre

<i>Treatment</i>											1956	1955
<i>Variety</i>											<i>N.A.</i>	<i>***</i>
Mauritius	...	...	...	...	...	...	...	...	...	...	251	211
New Era	...	...	...	...	...	...	...	...	...	...	140	220
Local	...	...	...	...	...	...	...	...	...	...	362	381
S.E.	...	...	...	...	...	...	...	...	...	...	—	±23
<i>Spacing</i>											<i>N.S.</i>	<i>N.S.</i>
Close	...	...	...	...	...	...	...	...	...	...	308	269
Wide	...	...	...	...	...	...	...	...	...	...	194	272
S.E.	...	...	...	...	...	...	...	...	...	...	—	±19
<i>Variety x Spacing</i>											<i>N.A.</i>	<i>N.S.</i>

<i>Treatment</i>							<i>Yield per acre</i>	<i>Increase over control</i>	<i>Percentage Increase</i>
<i>Sulphate of Ammonia:</i>									
Nil	n0	...	...	...	...	...	657		
60 lbs per acre	n1	...	...	...	...	...	742	+85***	12.9
120 lbs per acre	n2	...	...	...	...	...	743	+86***	13.1
S.E.	...	...	...	...	...	...	±16		
<i>Superphosphate:</i>									
Nil	p0	...	...	...	...	...	656		
60 lb per acre	p1	...	...	...	...	...	772	+116***	17.7
S.E.	...	...	...	...	...	...	±13		

TABLE 79—continued

*NxP Interaction**

											n0	n1	n2
p0	...	...	...	...	...	...	...	...	...	...	631	686	651
p1	...	...	...	...	...	...	...	...	...	...	683	799	835

S.E.=±23

1955-56

Treatment										Yield per acre	Increase over control	Percentage Increase
<i>Sulphate of Ammonia:</i>												
Nil	n0	...	...	...	...	...	...	...	...	823		
½ cwt per acre	n1	...	...	...	...	...	...	...	...	881	+58	7.0
1 cwt per acre	n2	...	...	...	...	...	...	...	...	922	+99*	12.0
S.E.	...	...	...	...	...	...	...	...	...	±25		
<i>Superphosphate:</i>												
Nil	p0	...	...	...	...	...	...	...	...	704		
½ cwt per acre	p1	...	...	...	...	...	...	...	...	945	+241***	34.2
1 cwt per acre	p2	...	...	...	...	...	...	...	...	978	+274***	38.9
S.E.	...	...	...	...	...	...	...	...	...	±25		

NxP Interaction N.S.

											n0	n1	n2
p0	...	...	...	...	...	...	...	...	...	...	688	717	705
p1	...	...	...	...	...	...	...	...	...	...	891	956	988
p2	...	...	...	...	...	...	...	...	...	...	889	969	1,074

S.E.=±43.

In both the series of experiments superphosphate has produced the most substantial significant response. Examination of the 1955-56 results shows that it is uneconomical to apply the second cwt of superphosphate.

In Table 80 results for the residual effects of fertilisers on the interplanted guineacorn are presented.

Sulphate of ammonia has produced no residual effect on the guineacorn. Superphosphate has produced a fairly substantial residual response. In the 1955-56 series of experiments 1 cwt of superphosphate produced a much larger residual response than did the ½ cwt level.

A summary of expected cash returns from the use of superphosphate, including the effects both on maize and the following guineacorn, are given in Table 81.

TABLE 80.—RESIDUAL EFFECTS OF FERTILISERS ON GUINEACORN, PAIYE
Yields in lb. Threshed Grain per acre

1952-54

Treatment										Yield per acre	Increase over control	Percentage Increase
<i>Sulphate of Ammonia:</i>											N.A.	
Nil	...	...	...	...	...	n0	...	...	...	483		
60 lb. per acre	...	...	...	...	...	n1	...	...	...	461	—22	—4.6
120 lb. per acre	...	...	...	...	...	n2	...	...	...	474	—9	—1.9
<i>Superphosphate:</i>												
Nil	...	...	...	...	...	p0	...	...	...	447		
60 lb. per acre	...	...	...	...	...	p1	...	...	...	498	+51	11.4

NxP Interaction.

											n0	n1	n2
p0	...	...	...	...	...	...	...	...	...	...	489	425	425
p1	...	...	...	...	...	...	...	...	...	...	476	496	522

1955-56

Treatment										Yield per acre	Increase over Control	Percentage Increase
<i>Sulphate of Ammonia:</i>											N.A.	
Nil	...	...	...	...	...	...	...	...	...	486		
½ cwt per acre	...	...	...	...	...	...	...	...	...	480	—6	—1.2
1 cwt per acre	...	...	...	...	...	...	...	...	...	481	—5	—1.0
<i>Superphosphate:</i>												
Nil	...	...	...	...	...	...	...	...	...	390		
½ cwt per acre	...	...	...	...	...	...	...	...	...	505	+115	29.5
1 cwt per acre	...	...	...	...	...	...	...	...	...	552	+162	41.5

NxP Interaction.

											n0	n1	n2
p0	...	...	...	...	...	...	...	...	...	...	402	386	381
p1	...	...	...	...	...	...	...	...	...	...	504	509	501
p2	...	...	...	...	...	...	...	...	...	...	551	544	562

TABLE 81.—EXPECTED FINANCIAL RETURNS FROM SUPERPHOSPHATE APPLIED TO MAIZE I.P.W. GUINEACORN, PAIYE

Superphosphate per Acre			Cost of Super-phosphate	Expected increase in Maize yield	Value of Maize increase	Expected increase in G'corn	Value of G'corn increase	Profit per Acre
				lb		lb		
1 cwt (1952-54)	...	...	17/-	179	40/-	83	16/-	39/-
1 cwt (1955-56)	...	...	34/-	274	61/-	162	32/-	59/-

Note: No differentiation has been made between 60 lb. per acre and $\frac{1}{2}$ cwt per acre.

The figures in Table 81 are based on an average value of £25 per ton for maize (July to September, 1956 average), and £22 per ton for guineacorn (December-February, 1956-57 average).

The returns on 1 cwt of superphosphate are higher relative to the $\frac{1}{2}$ cwt returns than would normally be expected as the 1 cwt figures are based only on 1955-56 data when yields were higher than in 1952-54.

(b) *Ilorin Farm*.—A trial of Nitrogen and Phosphate i.p.w., guineacorn has been carried out on Ilorin Farm for two years. The results are presented in Table 82.

TABLE 82.—N AND P ON MAIZE I.P.W. GUINEACORN, ILORIN
Yields in lb. Threshed Grain per acre

						1956		1955	
						Maize	G'corn	Maize	G'corn
<i>Sulphate of Ammonia:</i>						N.S.	N.S.	N.S.	N.S.
Nil	n0	...	...	...	...	719	402	541	487
$\frac{1}{2}$ cwt per acre	n1	...	...	...	...	813	375	640	514
1 cwt per acre	n2	...	...	...	...	725	379	671	551
<i>Superphosphate:</i>						N.S.	*	N.S.	N.S.
Nil	p0	...	...	...	...	799	350	631	521
$\frac{1}{2}$ cwt per acre	p1	...	...	...	...	661	389	629	495
1 cwt per acre	p2	...	...	...	...	796	416	592	536
S.E.	...	...	...	...	...	±55	±18	±41	±36
<i>NxP Interaction</i>						N.S.	N.S.	N.S.	N.S.

The only significant result obtained to date is the residual effect of 1 cwt of superphosphate on guineacorn. As 1956 was abnormal with a prolonged drought during the middle of the growing season this result must be treated with caution.

None of the interactions in this trial were significant. The effect of the fertilisers was possibly masked due to heavy dressings of farmyard manure in the previous years. The C.V. was high (26 per cent).

(b) *Dekina*.—A repeat of the Kabba trial carried out at Dekina failed due to drought.

(c) *Osara*.—A trial was carried out at Osara comparing two introduced maize varieties, Mexico I and Tsolo, with the local variety at different levels of fertiliser application. The results are given in Table 85.

TABLE 85.—MAIZE VARIETIES X N AND P, OSARA

Yields in lb. Threshed Grain per acre

<i>Treatment</i>											<i>Grain</i>
<i>Varieties</i>											<i>N.S.</i>
Local	...	...	...	...	...	...	...	...	...	...	349
Tsolo	...	...	...	...	...	...	...	...	...	...	463
Mexico I	...	...	...	...	...	...	...	...	...	...	528
S.E.	...	...	...	...	...	...	...	...	...	...	±44
<i>Fertilisers</i>											***
Nil	...	...	...	...	...	...	...	...	...	...	310
$\frac{3}{4}$ cwt S/Ammonia per acre	...	...	...	...	...	...	...	...	...	...	558
$\frac{1}{2}$ cwt Superphosphate per acre	...	...	...	...	...	...	...	...	...	...	335
$\frac{3}{4}$ cwt S/A + $\frac{1}{2}$ cwt Super per acre	...	...	...	...	...	...	...	...	...	...	584
S.E.	...	...	...	...	...	...	...	...	...	...	±22

VARIETY X FERTILISER INTERACTION ***

									n0p0	n1p0	n0p1	n1p1
Local	...	...	...	...	...	...	...	...	225	439	323	408
Tsolo	...	...	...	...	...	...	...	...	265	590	297	701
Mexico	...	...	...	...	...	...	...	...	439	645	386	643

S.E. = ±39

The main response of all varieties is to nitrogen; the introduced varieties tend to show a greater response to application of sulphate of ammonia than the local variety.

Yields were low due to drought.

RICE

Rice Fertiliser Trials

(1) *Plateau Province—Lowlands Farm*.—A trial was carried out for the first time of Nitrogen and Phosphate on rice grown under fadama (swamp) conditions. The rice was transplanted and was flooded for a period of about three weeks only. The fertilisers were applied to the plots and covered over before the seedlings were transplanted. No bunds were made between plots and no water control was possible. The results are given in Table 86.

The N x P interaction was not significant. The C.V., was high (51 per cent) attributable mainly to the effects of the drought.

(4) *Bornu Province—Jere Bowl.*—A trial of Nitrogen and Phosphate on direct seeded rice was carried out on the Jere Bowl for the first time. This is an area which is covered by free-flowing water for about three months of the growing season. The flood was abnormally high in 1956 and this caused severe damage to the trial which was accentuated by the external bund constructed around the experiment.

The results are presented in Table 89.

The C.V., was high (34 per cent) and yields were low. No trends emerge from the yield figures.

TABLE 89.—NITROGEN AND PHOSPHATE ON RICE, JERE BOWL
Yields in lb. Paddy per acre

<i>Treatment</i>	<i>Paddy</i>
<i>Sulphate of Ammonia:</i>	<i>N.S.</i>
Nil	831
1 cwt. per acre	798
1½ cwt. per acre	913
<i>Superphosphate:</i>	<i>N.S.</i>
Nil	980
1 cwt. per acre	816
1½ cwt. per acre	747
S.E.	±84
<i>NxP Interaction</i>	<i>N.S.</i>

(5) *Sokoto Province—Kware.*—A continuous trial of N.P.K., on transplanted rice has been in progress since 1952, but only in one year (1955) have reasonable yields been obtained, due mainly to loss of water control. The results available are presented in Table 90.

TABLE 90.—N.P.K. ON RICE, KWARE
Yields in lb. Paddy per acre

<i>Treatment</i>	1956	1955
<i>Sulphate of Ammonia:</i>	**	*
Nil	169	1,051
100 lb. per acre	234	1,239
200 lb. per acre	278	1,397
<i>Superphosphate:</i>	***	***
Nil	151	796
100 lb. per acre	263	1,389
200 lb. per acre	266	1,501
<i>Muriate of Potash:</i>	<i>N.S.</i>	<i>N.S.</i>
Nil	236	1,144
84 lb. per acre	221	1,328
168 lb. per acre	223	1,214
S.E.	±22	±83

Yields in 1956 were very low due to flood damage; the C.V. was excessive (50 per cent). However the response to fertilisers follows the same trends as in 1955. The N x K interaction was significant in 1956, showing that K reduced yields in the presence of N.

BENNISEED

Permanent D.N.P.K. Trial on Benniseed

Benue Province—Yandev.—The multifactorial D.N.P.K., trial at Yandev includes benniseed as one of the courses of the rotation. The results for two seasons are presented in Table 91.

TABLE 91.—D.N.P.K. ON BENNISEED, YANDEV
Yields of Benniseed in lb. of Seed per acre

<i>Treatment</i>								1952	1955	Mean	<i>Increase over Nil</i>
<i>Farmyard Manure: D</i>								N.S.	**		
Nil	...	...	...	...	...	...	...	422	287	355	
1 ton per acre	...	...	...	...	...	...	...	432	331	382	+27
2 tons per acre	...	...	...	...	...	...	...	433	317	375	+20
<i>Sulphate of Ammonia: N</i>								N.S.	***		
Nil	...	...	...	...	...	...	...	418	269	344	
50 lb. per acre	...	...	...	...	...	...	...	433	317	375	+31
100 lb. per acre	...	...	...	...	...	...	...	435	350	393	+49
<i>Superphosphate: P</i>								**	N.S.		
Nil	...	...	...	...	...	...	...	398	296	347	
50 lb. per acre	...	...	...	...	...	...	...	471	324	398	+51
100 lb. per acre	...	...	...	...	...	...	...	418	315	367	+20
<i>Muriate of Potash: K</i>								N.S.	N.S.		
Nil	...	...	...	...	...	...	...	415	311	363	
25 lb. per acre	...	...	...	...	...	...	...	448	316	382	+19
100 lb. per acre	...	...	...	...	...	...	...	424	308	366	+3
S.E.	...	...	...	...	...	...	...	±15	±9		
<i>Interactions (linear effect only)</i>											
	DxN	...	...	...	...	...	...	—46	—30	—38	
	DxP	...	...	...	...	...	...	—45	—18	—32	
	DxK	...	...	...	...	...	...	+37	+11	+24	
	NxP	...	...	...	...	...	...	+5	—23	—9	
	NxK	...	...	...	...	...	...	+5	—12	—4	
	PxK	...	...	...	...	...	...	+32	—22	+5	
S.E.	...	...	...	...	...	...	...	±26	±15		

The results for the two seasons are rather inconsistent with farmyard manure and sulphate of ammonia producing significant increases in 1955 but not in 1952, while superphosphate was significant in 1952 but not in 1955.

Considering the increase for the two seasons, results indicate that D. N and P have all produced increases in yield, the maximum increases being produced by 100 lb. of sulphate of ammonia (an increase of 14 per cent) and 50 lb., of superphosphate (an increase of 15 per cent).

Farmyard manure gave only small increases in yield as did muriate of potash.

The interactions showed the same inconsistency as the main effects.

D x N and D x P were negative in both years, the effect being quite large. D x K was positive in both years. The other interactions changed sign in the two seasons under review and the mean effects were not large.

Cultural Trials on Benniseed

Kabba Province—Osara.—A trial was carried out at Osara comparing two varieties of benniseed grown broadcast on the flat and sown spaced on the ridge. In Tiv Division of Benue Province benniseed is sown broadcast on the flat while in Igbirra Division of Kabba Province farmers usually sow at two feet spacing on three feet ridges. The results are presented in Table 92.

TABLE 92.—VARIETY x PLANTING METHOD ON BENNISEED, OSARA
Yields in lb. Threshed Seed per acre

<i>Treatment</i>										<i>Seed</i>
<i>Variety:</i>										N.S.
Improved Yandev	...	...	...	...	...	...	...	...	...	204
Igbirra Local	...	...	...	...	...	...	...	...	...	166
S.E.	...	...	...	...	...	...	...	...	...	±20
<i>Planting Method:</i>										***
Broadcast on Flat	...	...	...	...	...	...	...	...	...	208
2 feet on 3 feet ridges	...	...	...	...	...	...	...	...	...	162
S.E.	...	...	...	...	...	...	...	...	...	±8

Variety x Planting Method *

							<i>Broadcast</i>	<i>Ridges</i>
Yandev	...	...	...	...	...	...	241	166
Local	...	...	...	...	...	...	174	157

S.E. ±11

Broadcasting on the flat gave higher yields than sowing spaced on ridges and the interaction showed that this was more the case with the Improved Yandev variety than with Igbirra Local. There was no significant difference in yield between Igbirra Local sown broadcast on the flat and sown on ridges. The higher yields from broadcasting on the flat compared to sowing spaced on ridges is probably due simply to higher plant populations with the broadcast treatment.

TOBACCO

Fertiliser Trials

Zaria Province—Maigana.—An N.P.K., trial on tobacco has been carried out for two years at Maigana. The results are presented in Table 93.

TABLE 93.—N.P.K. ON TOBACCO, MAIGANA
Yields in lb. Green Leaf per acre

Treatment										1956	1955
<i>Sulphate of Ammonia:</i>										N.S.	N.S.
Nil	...	...	...	...	...	...	...	...	...	1,709	1,132
½ cwt. per acre	...	...	...	...	...	...	...	...	...	1,865	1,099
1 cwt. per acre	...	...	...	...	...	...	...	...	...	1,974	973
<i>Superphosphate:</i>										**	***
Nil	...	...	...	...	...	...	...	...	...	1,337	366
½ cwt. per acre	...	...	...	...	...	...	...	...	...	1,941	1,283
1 cwt. per acre	...	...	...	...	...	...	...	...	...	2,271	1,555
S.E.	...	...	...	...	...	...	...	...	...	±183	±83
<i>Sulphate of Potash:</i>										N.S.	***
Nil	...	...	...	...	...	...	...	...	...	815	1,155
½ cwt. per acre	...	...	...	...	...	...	...	...	...	776	861
S.E.	...	...	...	...	...	...	...	...	...	±113	±51

As in 1955 superphosphate has produced the only significant increase in yield; however the C.V., was excessive (60 per cent.) No interaction was significant this year and potash did not produce a significant decrease in yield.

Grading of the 1956 crop was carried out by the Nigerian Tobacco Company and analysis of the graded leaf data was carried out under various readings. The results are presented in Table 94.

TABLE 94—N.P.K. ON TOBACCO, MAIGANA
Summary of yields in lb. Per acre and cash value in shillings

Treatment	1956				
	Cured Leaves				
	Grade I	Grade II	Grade III	Total in lb./acre	Cash value in shillings
<i>Sulphate of Ammonia:</i>					
Nil	*	N.S.	N.S.	N.S.	N.S.
½ cwt. per acre	42	68	210	320	287.5
1 cwt. per acre	83	87	183	353	348.7
S.E.	63	88	244	395	365.2
<i>Superphosphate:</i>					
Nil	***	*	N.S.	*	***
½ cwt per acre	31	62	183	275	244.3
1 cwt per acre	51	83	231	365	332.0
S.E.	106	99	222	428	425.2
S.E.	±11	±10	±29	±35	±31.4
<i>Sulphate of Potash:</i>					
Nil	N.S.	N.S.	N.S.	N.S.	N.S.
½ cwt per acre	57	73	186	316	297.5
S.E.	56	84	153	293	283.2
S.E.	±7	±10	±15	±19	±18.5

Sulphate of ammonia at $\frac{1}{2}$ cwt per acre produced a significant increase in Grade I leaf but this was not sufficient to produce a significant increase in cash value per acre. Superphosphate produced significant increases in Grade I and Grade II leaf and in total yield of cured leaf. The cash value per acre of the leaf was also significantly increased.

ROTATIONS

None of the four rotation trials in progress is due to be reported this year.

FALLOWS

There was a total of nine fallow trials in progress during 1956-57 but the majority of these are not at the reporting stage.

(1) *Niger Province—Bida Farm—Type of Fallow.*—In 1950 a trial was laid down to compare the effects of various types and lengths of fallow on crop yields, but has been abandoned as in practice all types almost immediately reverted to *Andropogon gayanus* (gamba).

(2) *Bornu Province—Maiguduri—Length of Fallow Trial.*—A trial has been in progress at Maiduguri since 1951 comparing the effect of two, four and six year spineless karangiya (*Cenchrus prieurii*) fallows on the yields of the rotation millet i.p.w. cowpeas, guineacorn, groundnuts.

The 6-year fallows were cropped for the first time in 1956 and comparison of the yields of millet obtained from plots coming out of two, four and six-year fallow are given in Table 95.

TABLE 95.—LENGTH OF SPINELESS KARANGIYA FALLOW, MAIDUGURI
Yields in lb. Threshed Millet per acre

<i>Length of Fallow</i>												<i>Grain</i>
2 years	...	...	...	...	...	...	...	...	...	...	...	425
4 years	...	...	...	...	...	...	...	...	...	...	...	258
6 years	...	...	...	...	...	...	...	...	...	...	...	564
Mean	...	...	...	...	...	...	...	...	...	...	...	416

The interplanted cowpeas crop was a failure due to desert locust attack. The reason for the low yields from the four year fallow is probably due to variation between plots (the yields are only based on four plots for each length of fallow).

(3) *Benue Province—Yandev—Types of Fallow.*—A trial has been concluded at Yandev comparing planted woody shrubs (*Lophira alata* and *Afzelia africana*) at different spacings, with gamba fallow. The length of fallow used was three years and the effect was tested on yields of crops in the following three-year rotation: yams and cowpeas; millet and guineacorn; benniseed.

Fallow periods occurred in 1947-49 and 1953-55.

The results are presented in Table 96.

TABLE 96.—WOODY SHRUBS VERSUS GAMBA FALLOW, YANDEV

Yields in lb. per acre

<i>Type of Fallow</i>	1950	1951	1952	1956
	<i>Yams</i>	<i>Millet plus Guineacorn</i>	<i>Benniseed</i>	<i>Yams</i>
	N.S.	Sig.	Sig.	Sig.
Gamba fallow	13466	1229	354	9999
Shrubs 12 ft. x 6 ft.	13348	1246	301*	9948
Shrubs 6 ft. x 6 ft.	12607	1006*	210*	8837*

The results indicate that woody shrubs are generally not as effective as fallow cover and fertility builder as gamba. There is also considerable difficulty in establishing these shrubs. This trial was actually started in 1941 but the woody shrubs were not effectively established until 1947.

CROPPING SYSTEMS

(1) *Niger Province—Bida—Hilling versus Ridging.*—An experiment has been in progress at Bida since 1954 to compare over a period the standard Agricultural Department 3 feet ridges with local $4\frac{1}{2}$ feet ridges and the common local practice of planting on hills. The full rotation cycle of guineacorn, groundnuts, and cassava has now been completed and the results are given in Table 97.

TABLE 97.—HILLING VERSUS RIDGING, BIDA

Yields in lb. per acre for Guineacorn and Groundnuts: cwt per acre for Cassava

<i>Treatment</i>	1954	1955	1956
	<i>Guineacorn</i>	<i>Groundnuts</i>	<i>Cassava</i>
	N.S.	**	N.S.
Dept. ridges 3 feet	242	423	75.4
Native ridges $4\frac{1}{2}$ feet	247	321	75.0
Hills 4 feet apart approximate	215	287	79.4
S.E.	±20	±23	±5.04

Plant populations are the same in each treatment; the different arrangements of plants and the different cultural treatments appear to have produced little effect except in the case of groundnuts. The significantly higher yield in the case of groundnuts is possibly due to the lower incidence of rosette as the 3 ft ridges would have a more uniform continuous cover of haulms than either $4\frac{1}{2}$ ft ridges or hills. Previous work has shown that density of stand is an important factor in reducing rosette incidence.

(2) *Benue Province—Yandev—Rates of Farmyard Manure in Continuous Cropping.*—An experiment was conducted at Yandev from 1940 to 1951 to determine the optimum rate of application of farmyard manure to a rotation of yams, grain and benniseed. The rates of farmyard manure were 1, 2 and 3 tons per acre applied to the grain crop only. It was found that the plots receiving 1 ton per acre were declining in fertility; 2 tons per acre plots maintained fertility while the 3 tons per acre plots were gradually improving.

In 1952 the treatments were changed as follows:—

- (A) Increase 1 ton to $1\frac{1}{2}$ tons.
- (B) Increase 2 tons to 3 tons.
- (C) Decrease 3 tons to nil.

The results to date are given in Table 98.

TABLE 98.—RATES OF F.Y.M. IN CONTINUOUS CROPPING, YANDEV
Yields in lb. per acre

	1952	1953	1954	1955	1956
<i>Treatments</i>	<i>Guineacorn plus Millet</i>	<i>Benniseed</i>	<i>Yams</i>	<i>Guineacorn plus Millet</i>	<i>Benniseed</i>
<i>Farmyard Manure:</i>	<i>N.S.</i>	<i>N.S.</i>	<i>N.S.</i>	<i>Sig.</i>	<i>Sig.</i>
A $1\frac{1}{2}$ tons per acre ...	728	100	7,411	347	79
B 3 tons per acre ...	938	112	8,165	517*	102*
C Nil	643	108	8,262	210	86

Note: *Indicates that the yield is significantly better than A.

Significance tests were based on differences from A of B and C. Results to date indicate that treatment B (increased from 2 to 3 tons) has significantly increased the yield of the first two crops in the second cycle. Treatment C (reduced from 3 tons to nil) is still maintaining yields presumably on the residual effects of the farmyard manure applications made from 1940-51. Comparisons between cycles are difficult because of marked seasonal effects on yields as, for example, when grain yields for 1952 and 1955 are compared. It is still too early to draw any conclusions from this trial.

WEED CONTROL

Samaru.—Control of Cynodon dactylon

(1) *Dry Season Cultivation.*—An eight acre field heavily infected with *C. dactylon* was ploughed with a Ransome's 'Durotrac' mouldboard plough at the end of the rains in November, 1955. Ploughing was to a depth of about eight inches. During the dry season a Ferguson spring tine cultivator was used whenever a flush of the weed appeared. A further ploughing was carried out in April, 1956, using a Ransome's 'Solotrac' mouldboard at rather variable depths of from six to twelve inches. The spring tine cultivator

was used again as required until the end of June when the field was ridged for planting alternate strips of cotton and guineacorn (for a cotton pathology trial). By the end of June the field could be said to be virtually free of *C. dactylon*.

However the patchy crops of guineacorn and cotton showed that the ploughing had been too deep and had presumably resulted in a large amount of sub-soil being brought to the surface although this was not apparent at the time the dry season ploughing was done.

The field was still almost completely free of *C. dactylon* at the end of the season, except at the edges.

(2) *Maleic hydrazide trial*.—As work elsewhere had indicated that maleic hydrazide has been effective in controlling *Agropyron repens*, this chemical was used on a trial on a four acre field that carried a very heavy cover of *C. dactylon*.

Maleic hydrazide was applied at three rates: 4 lb., 8 lb. and 16 lb. per acre using knapsack spray on the 26th June when the *C. dactylon* was growing vigorously. The whole field was ploughed using a reversible mould-board plough on the 2nd July; the ploughing was not well done and complete burying of the grass was not achieved. Cotton was sown on the flat, using a bullock-drawn planter, on the 11th July.

The treatments had no effect on the grass and eventually the cotton was ploughed in to save the excessive weeding costs that would have been necessary to produce a crop. The cotton showed no effects from the maleic hydrazide applications.

FARM MACHINERY

During the year several items of ox-drawn equipment were tested under field conditions by the Agronomy Section.

The basic ox-drawn equipment used on the farm and by mixed farmers in the Northern Region consists of a ridging plough for all cultivations and a cart for carrying manure, farm produce, etc. A result of this is that the work animals play only a limited role in farming operations; with most crops, the ridging plough is used only for splitting of old ridges or making new ridges for planting. Later in the season one or two re-ridgings with the plough are carried out both for weed control and to rebuild ridges. A large amount of hand work is still required in planting, thinning and weeding.

Various implements have been under test which, it is hoped, will reduce the amount of hand labour in farm operations and increase the amount of work that can be done by the work animals.

(1) *Cultivators*.—Several types have been tested. The main use of the implements is for inter-row cultivation before crops are big enough for re-ridging. This eliminates some hand weeding.

(a) *Rhino*.—This is a German cultivator which has been in use at Samaru for three years. It is a light implement, adjustable in width which

has proved very suitable for inter-row cultivations. Its main drawbacks are its light construction and wooden handles which make it very susceptible to breakage.

(b) *Safim S 51 and Mahon (Massey-Harris, S. Africa).*—These are similar to the Rhino but are of all-steel construction and generally much more strongly built. The S 51 is preferred to the Mahon as it is lighter and simpler in construction.

(2) *Planters.*—Hand planting is a slow operation and often means that parts of fields miss optimum planting conditions. Farmers also are loath to use fertilisers on crops as this is an additional operation which makes the planting operation even longer. The use of a planter with a fertiliser attachment means that planting can be carried out more quickly making the most of good planting conditions, and also planting and fertiliser application can be done as one operation. Several planters have been tested.

(a) *Safim (Massey-Harris, S. Africa).*—This planter has been in use at Samaru since 1953 and after initial modifications has proved a very satisfactory implement. Like the majority of animal-draught implements it is designed for use on the flat, but with a little practice the average experienced cattle man can manipulate it on top of the ridge. One man with two work animals is able to plant two to three acres per work day of approximately seven hours.

(b) *Super Eco. (C.F.A.O., Senegal French W.A.).*—Three types of this machine have been tried. As a result of advice to the manufacturer on experience with the first two machines, a new prototype has been produced suitable for working on the ridge. The new model also has a fertiliser distributor which was not fitted to the earlier types. The prototype was found the most satisfactory planter for use on the ridge yet tried. Spacing of seed and accuracy of fertiliser rate are extremely good. The machine has not been in use long enough to know how well it will stand up to normal farm use.

(c) *Buffalo Drill (S. Africa).*—Two machines of this make were tried. They are very similar to the Safim in general design. One type operated the seed and fertiliser box with a chain drive. This was not found very satisfactory as it blocked with soil under wet conditions; a mixed farmer in the bush would find replacement of links of the chain difficult.

The other type operated on a shaft drive (similar to the Safim) and was much more satisfactory. A general objection to the Buffalo design was the fact that neither the seed nor fertiliser boxes were readily removable; this is important if blockages occur and the boxes have to be emptied.

(d) *General.*—Most planters tested require a considerable amount of modification and testing to obtain the optimum seed rate for different crops. Due to pressure of other work the Agronomy Section is not able to carry out as much work on this as would be desirable. When modifications are suggested manufacturers have not been very enthusiastic in incorporating these alterations, stating that the potential market is too small to warrant the cost of the changes that are necessary.

III—Botany and Plant Pathology Section

By

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A.—GENERAL

The senior staff position has again improved with the arrival of one Botanist and one Specialist Superintendent (Horticulture).

The experimental programme conducted by this section was expanded during the year. The work on cereals and Nigerian food crops has increased considerably at Samaru. The Groundnut Sub-Station at Kano has been established and much of the work on groundnuts has been transferred there.

The arrival of a Horticultural Superintendent late in the year has enabled us to improve the methods used in propagation in the nursery.

The equipment for the Plant Growth Chamber has all been received.

Office and laboratory facilities are taxed to the maximum and, together with a serious shortage of junior technical staff, are the limiting factors in our work.

B.—CROPS

GROUNDNUTS

(Arachis hypogaea).

The work on groundnuts has been accelerated with the opening of the Sub-Station at Kano. Experiments have been conducted at Samaru and Kano as well as in the Provinces. All work for the main groundnut belt is centred on Kano now while Samaru retains the breeding programme for the rest of the Region.

Variety Trials—Samaru

The results obtained in variety trials at Samaru are given below. These trials are part of a long-term programme and previous results are to be found in past annual reports.

Main Variety Trial

This series of yield trials has compared the best yielding groundnut varieties at Samaru for the past eleven years. Results are shown in Table 9 together with those of the last three years.

The main variety trial gave excellent yields but results were not significant. The only new comer L 200 promoted from the second variety trial after two successful seasons did well coming 4th with 1,666 lb. of kernels per acre. 14-T-12 disappointed this year slumping to 13th place from 2nd in its first introduction from the second variety trial. This trial has, over the last few years, given unpredictable and ambiguous results. These may be caused by the large seasonal variation of rainfall over the last few years and also the different soil types on the various sites at Samaru. A possible explanation may be the relative amount of gleaning done. It was noticed that this year the same standard varieties in the second variety trial, Samaru

38 and Castle Cary, yielded considerably less (30-40 per cent reduction) although both trials were planted in the same field within one day of each other. Both trials received the same cultural treatments except that the gleaning was done more thoroughly in the main trial. With thorough gleaning all varieties show their full yield potential but with poor gleaning bunch types and strains with strong gynophores will appear relatively better than the others.

TABLE 99.—GROUNDNUT MAIN VARIETY TRIAL, SAMARU
Yields in lb. Kernels per acre

<i>Varieties</i>	1956	1955	1954	1953
	<i>N.S.</i>	***	<i>N.S.</i>	***
MJ 371	1,795 (1)	1,103 (8=)	1,043 (7)	1,186 (12)
MG 371	1,745 (2)	1,103 (8=)	1,257 (1)	1,239 (7)
Samaru 542 (L 234)	1,714 (3)	1,289 (1)	976 (12)	—
L 200	1,666 (4)	—	—	—
Samaru 38	1,655 (5)	924 (14)	1,052 (5)	1,253 (3=)
Kano 50	1,653 (6)	1,129 (6)	939 (14)	1,249 (5)
MK 374	1,620 (7)	1,188 (4)	980 (11)	1,244 (6)
Samaru 541 (L 235)	1,604 (8)	1,192 (3)	985 (10)	—
MJ 374	1,599 (9)	996 (13)	1,018 (8)	1,228 (8)
Samaru 544 (L 250)	1,596 (10)	1,070 (12)	1,115 (3)	—
Samaru 543 (L 245)	1,584 (11)	1,092 (10)	1,093 (4)	—
Castle Cary	1,542 (12)	1,181 (5)	1,152 (2)	1,223 (9)
14-T-12	1,499 (13)	1,218 (2)	—	—
MK 383	1,478 (14)	1,109 (7)	951 (13)	1,253 (3)
Samaru 545 (L 60)	1,439 (15)	1,071 (6)	989 (9)	—
Mache Atsugune		876 (15)	888 (15)	1,274 (1)
ML 372			1,048 (6)	1,257 (2)
ML 3710				1,198 (11)
ML 384				1,148 (13)
S. 38 ex Kontagora				1,211 (10)
ML 378				1,127 (14)
MPA				842 (15)
S.E.	±230	±61	±47	±53

Second Variety Trial

The marked seasonal fluctuation in these trials was noticed once again 18-B-138 which headed the list has risen from the penultimate position from the year before. L 121, a quite creditable fifth the previous year, slumped this year to bottom place. The steady performance of L 258 was encouraging.

The history of Mache Atsugune is rather illuminating. In this trial it has always done fairly well except in 1954 when the trial was not significant. On promotion to the First variety trial in 1953 it was first of a rather motley

selection but in 1954 and 1955 it was a poor bottom. This suggests that the varieties in the Main Trial are more uniform and that there is a real difference between those in the Main and Second variety trials. Of the five selections derived from the New Selections trial, MU 537B, L 53, 23-T-42, L 366, AU 531B, the first two did well in this their first year, but the other three were in the bottom half occupying positions 10, 11 and 12.

TABLE 100.—GROUNDNUT NEW SELECTIONS TRIAL, SAMARU

Yields in lb. Kernels per acre

<i>Varieties</i>								1956 *	1955 N.S.	1954 *
L 272	...	...	...	...	...	...	...	325 (1)	1,160 (7)	605 (9)
AU 531A	...	...	...	...	...	...	...	318 (2)	1,118 (9=)	544 (13)
MAB 371	...	...	...	...	...	...	...	315 (3)	1,034 (15)	
MU 534	...	...	...	...	...	...	...	305 (4)		
Little Cary	...	...	...	...	...	...	...	305 (4=)	1,176 (6)	659 (4)
Samaru 38	...	...	...	...	...	...	...	287 (6=)	1,063 (12)	692 (3)
L 366	...	...	...	...	...	...	...	287 (6=)	1,105 (11)	652 (5)
AU 532	...	...	...	...	...	...	...	285 (8)	1,134 (8)	551 (12)
MAB 166	...	...	...	...	...	...	...	265 (9)	1,042 (13)	625 (7)
MAB 371	...	...	...	...	...	...	...	261 (10)	1,118 (9=)	
AU 531B	...	...	...	...	...	...	...	251 (11)	1,042 (14)	571 (10)
MU 534	...	...	...	...	...	...	...	226 (12)		
AU 542	...	...	...	...	...	...	...	199 (13)		
MU 542	...	...	...	...	...	...	...	192 (14)		
MU 541	...	...	...	...	...	...	...	183 (15)		
MU 537B	...	...	...	...	...	...	...		1,252 (1)	612 (8)
L 366	...	...	...	...	...	...	...		1,244 (2)	538 (14)
MAB 371	...	...	...	...	...	...	...		1,202 (3)	565 (11)
23-T-42	...	...	...	...	...	...	...		1,193 (4)	504 (15)
AU 531B	...	...	...	...	...	...	...		1,185 (5)	632 (6)
MU 537A	...	...	...	...	...	...	...			739 (1)
AU 531B	...	...	...	...	...	...	...			706 (2)
S.E.	...	...	...	...	...	...	...	±32	±69	±46

A disappointing feature of this trial is that since it was started in 1954 the newly introduced selection has done well, except perhaps MAB 371 and MU 534 third and fourth respectively. The upward trend of many selections such as L 272 and AU 531A can almost entirely be related to the practice of picking off the best varieties for the Second variety trial, e.g. first two in 1954, first five in 1955. It is hoped that the new selection programme now in hand, together with the large number of new introductions recently acquired, will give some promising new material for this trial.

TABLE 101.—GROUNDNUT EARLY MATURING VARIETIES TRIAL, SAMARU
Yields in lb. Kernels per acre

Varieties					1956 *	1955 ***	1954 *	1953 ***
Valencia	...	...	...	...	721 (1)	862 (4)	338 (6)	781 (6)
MU 537A	...	...	...	...	692 (2)			
279-6	...	...	...	...	641 (3)	1,059 (3)	389 (3)	1,130 (1)
278-4	...	...	...	...	610 (4)	667 (9)	387 (4)	966 (2)
WU 531B	...	...	...	...	587 (5)			
Toro	...	...	...	...	556 (6)	857 (5)	330 (7)	487 (9)
Kono	...	...	...	...	552 (7)	751 (7)	308 (8)	775 (7)
Spanish 205	...	...	...	...	484 (8)	741 (8)	415 (2)	949 (3)
Natal Common	...	...	...	...	422 (9)	772 (6)	356 (5)	876 (5)
Dixie Runner	...	...	...	...		1,245 (1)	441 (1)	945 (4)
Philippine White	...	...	...	...		1,190 (2)	263 (9)	770 (8)
S.E.	...	...	...	...	±57	±87	±34	±75

This trial was altered this year in that both the design and the component varieties were changed. The design was basically the same but the number of replications was doubled. Dixie Runner and Philippine White were omitted because they are not true early maturing varieties, maturing some ten to fourteen days later than the rest. As a result there has been a reshuffle in positions with Valencia improving to first place. 279-6 has maintained a high placing for the fourth successive year and 278-4 has once again realigned itself with it after such a poor showing in 1955. It is probable that this poor showing in 1955 was a chance result as it is the only time these two varieties have been significantly different from each other at Samarau or at any out-station.

The newly introduced varieties here made a good showing especially MU 537A. This was brought from last year's Second Variety Trial where it did well and was found to be early maturing.

The eclipse of Spanish 205 and Natal Common over the last two years, especially that of the former, is surprising and almost inexplicable except that climatic conditions in both years were exceptional; excessive rainfall in 1955 possibly led to heavy *Cercospora* spp. leaf spot attack on the susceptible Spanish 205, and a drought was experienced leading to late planting.

Bida Locals versus Samarau 38 and Castle Cary Yield Trial

This trial, instituted this year, was to compare six local varieties from Bida with the standard varieties Samarau 38 and Castle Cary. These were all reputed to be upright varieties but they proved to be rather mixed with a lot of spreading types evident. These were all rogued out so that the final stand counts were so depleted as to invalidate any analysis. One variety L 941, proved to be an early maturing type and also seemed to be a heavy yielder. The trial will be repeated in 1957 with, it is hoped, pure strains

Hybridization Programme

Several attempts at producing both inter and intra specific hybrids were made during the year. The first series made during the dry season did not produce gynophores. The second series was made during the normal season but for the first time in an enclosed greenhouse. Gynophores developed but then aborted, probably due to high humidity.

The F 3's of crosses made in 1952 were progeny rowed from selections made in 1955 and the bulked F 3's also grown. All the resulting F 4's were scored for growth habit and nut character and further selections made. Noticeable segregates were still appearing especially in testa colour and growth habit.

Introductions

An extremely large number of introductions was made from other territories. Over 300 varieties were received during the year, notably from Sudan and India and also from Australia, South Africa, Russia, Philippines and the United State of America. These, together with another 100 received at the end of the previous season, were grown at Samaru and all were scored for habit and pod type.

Size of Seed Yield Trial

This trial devolves from the previous work on size of seed and germination potential that was reported in 1955. In the year now reported a full scale trial was laid down with the object of determining the effect of different sizes of seed on yield. The very dry conditions that prevailed after planting resulted in a failure of all but the largest size seeds which confirms the previous work on germination but precluded any analysis to determine effect on yield per se".

Variety Trials—Outstations

This year there were nine variety trials at eight different stations. Three of these, those at Azare in Bauchi Province, Pategi in Ilorin Province and Zaria in Adamawa Province, started this year.

The best yields were recorded at Gusau with yields over 1,100 lb. per acre but the trial gave no significant result. Yields of over a thousand pounds per acre were obtained at Kafinsoli where the strain L 245 yielded 1,072 lb.

Poor yields were obtained at Zonkwa and Yandev and here the early maturing varieties seem to do better.

TABLE 102.—GROUNDNUT VARIETY TRIAL, GUSAU
Yields in lb. Kernels per acre

<i>Varieties</i>											1956 N.S.	1955 N.S.
L 266	...	...	...	...	...	...	...	...	...	...	1,166 (1)	1,156 (4)
L 245	...	...	...	...	...	...	...	...	...	...	1,139 (2)	1,220 (2)
L 234	...	...	...	...	...	...	...	...	...	...	1,118 (3)	1,188 (3)
Castle Cary	...	...	...	...	...	...	...	...	...	...	1,109 (4)	1,135 (7)
L 250	...	...	...	...	...	...	...	...	...	...	1,105 (5)	1,251 (1)
L 235	...	...	...	...	...	...	...	...	...	...	1,094 (6)	1,148 (6)
L 258	...	...	...	...	...	...	...	...	...	...	1,062 (7)	1,154 (5)
S.E.	...	...	...	...	...	...	...	...	...	...	±30	±44

This trial was again not significant but the results are still encouraging. The strains L 245 and L 234 have maintained their position of second and third respectively, and yields have once again been good.

TABLE 103.—GROUNDNUT VARIETY TRIAL, AZARE
Yields in lb. Kernels per acre

<i>Varieties</i>											1956*
L 121	...	...	...	...	...	...	...	...	...	...	802
Kano 50	...	...	...	...	...	...	...	...	...	...	742
Local Spreading	...	...	...	...	...	...	...	...	...	...	661
L 200	...	...	...	...	...	...	...	...	...	...	649
Castle Cary	...	...	...	...	...	...	...	...	...	...	644
L 258	...	...	...	...	...	...	...	...	...	...	637
L 260	...	...	...	...	...	...	...	...	...	...	631
S.E.	...	...	...	...	...	...	...	...	...	...	±38

This trial is a new one and yields are quite good. L 121 is significant better than all others except Kano 50. The Local is not significantly better than any of the rest despite its position. This trial will be repeated in 1957 with two other "L" strains replacing the last two in this trial.

TABLE 104.—GROUNDNUT VARIETY TRIAL, KAFINSOLI
Yields in lb. Kernels per acre

<i>Varieties</i>										1956 *	1954 N.S.
L245	...	...	...	...	...	...	...	...	...	1,072 (1)	—
L250	...	...	...	...	...	...	...	...	...	1,068 (2)	—
L250	...	...	...	...	...	...	...	...	...	1,002 (3)	1,224 (2)
Yan Karachi	...	...	...	...	...	...	...	...	...	966 (4)	1,104 (7)
MJ371	...	...	...	...	...	...	...	...	...	962 (5)	1,245 (1)
L23710	...	...	...	...	...	...	...	...	...	942 (6)	1,153 (4)
Little Cary	...	...	...	...	...	...	...	...	...	929 (7)	1,211 (3)
Local Spreading	...	...	...	...	...	...	...	...	...	856 (8)	1,037 (9)
MJ374	...	...	...	...	...	...	...	...	...	832 (9)	1,082 (8)
Tudun Wada	...	...	...	...	...	...	...	...	...	—	1,143 (5)
Dixie Runner	...	...	...	...	...	...	...	...	...	—	1,121 (6)
S.E.	...	...	...	...	...	...	...	...	...	±48	±93

This trial could not be planted in 1955 so it is only in its second year. This year's results are encouraging in that the strains L245 and L250, introduced this year in place of Tudun Wada and Dixie Runner, were 1st and 2nd respectively and were both significantly better than the standard Little Cary and the local. MJ374 unaccountably has done badly again and Yan Karachi will be replaced in 1957 by Samaru 38 and L235.

TABLE 105.—GROUNDNUT EARLY MATURING VARIETIES TRIAL, ZONKWA
Yields in lb. Kernels per acre

<i>Varieties</i>										1956 N.S.	1955 **	1954 N.A
Dixie Runner	...	...	...	...	...	...	...	...	...	371 (1)	335 (1)	107
Atsugune	...	...	...	...	...	...	...	...	...	360 (2)	334 (2)	85
L250	...	...	...	...	...	...	...	...	...	343 (3)	247 (5)	168
Philippine White	...	...	...	...	...	...	...	...	...	339 (4)	294 (3)	104
Atsugune	...	...	...	...	...	...	...	...	...	315 (5)	209 (8)	114
L250	...	...	...	...	...	...	...	...	...	290 (6)	253 (4)	119
L24	...	...	...	...	...	...	...	...	...	288 (7)	233 (6)	104
L26	...	...	...	...	...	...	...	...	...	277 (8)	247 (5)	112
Local Common	...	...	...	...	...	...	...	...	...	253 (9)	222 (7)	127
S.E.	...	...	...	...	...	...	...	...	...	±28	±23	—

The results in this trial have followed the same general pattern of last year but with the absence of significant differences. Dixie Runner and Atsugune again head the list and Natal Common is again at the bottom.

TABLE 106.—GROUNDNUT LATE MATURING VARIETIES TRIAL, ZONKWA
Yields in lb. Kernels per acre

<i>Varieties</i>										1956 N.S.	1955 N.A.	1954 N.A.
Mk 383	...	...	...	...	...	...	...	...	...	159	265	52
ML 372	...	...	...	...	...	...	...	...	...	157	226	42
MG 371	...	...	...	...	...	...	...	...	...	151	269	50
MJ 374	...	...	...	...	...	...	...	...	...	129	252	33
MK 374	...	...	...	...	...	...	...	...	...	125	211	54
ML 3,710	...	...	...	...	...	...	...	...	...	124	271	54
Samaru 38	...	...	...	...	...	...	...	...	...	124	256	59
Castle Cary	...	...	...	...	...	...	...	...	...	114	289	39
Zonkwa Local	...	...	...	...	...	...	...	...	...	101	165	60
S.E.	..	...	...	...	...	...	...	...	...	±22	—	—

This trial has had an unfortunate history for in 1954 no analysis was made because yields were too low and in 1955 an analysis was impossible as insufficient seed was available for some varieties. Thus 1956 is the first year that can be seriously considered and even then although all other varieties outyielded Zonkwa Local, the trial was not significant.

Overall, the consistently low yields are causing doubt as to the usefulness of groundnuts at Zonkwa. In contrast however an early variety in 1948 yielded over 1,000 lb. kernels per acre. It has therefore been decided to try again with a trial containing both late and early types.

TABLE 107.—GROUNDNUT VARIETY TRIAL, YOLA
Yields in lb. Kernels per acre

<i>Varieties</i>										1956 ***
MK 383	...	...	...	...	...	...	...	...	...	495
L 260	...	...	...	...	...	...	...	...	...	430
MK 374	...	...	...	...	...	...	...	...	...	375
Castle Cary	...	...	...	...	...	...	...	...	...	361
L 200	...	...	...	...	...	...	...	...	...	321
MJ 374	...	...	...	...	...	...	...	...	...	247
L 258	...	...	...	...	...	...	...	...	...	195
S.E.	...	...	...	...	...	...	...	...	...	±31

In this trial MK383 is outstanding being significantly better than all the rest except L260. The best yields are all from late uprights but a trial in 1953 showed that Natal Common, an early, could give a reasonable yield so that this trial next year will contain the best 4 late uprights, 4 early maturing varieties and one local variety.

TABLE 108.—GROUNDNUT VARIETY TRIAL, YANDEV
Yields in lb. Kernels per acre

<i>Varieties</i>	1956 ***	1955 N.S.	1954 ***	1953 N.S.	1952 **
Spanish 205	205 (1)	505 (1)	629 (2)	175 (1)	858 (1)
Natal Common	184 (2)	424 (2)	663 (1)	141 (2)	779 (4)
78-4	173 (3)	422 (3)	—	—	—
79-6	170 (4)	326 (4)	—	—	—
IL 372	127 (5)	79 (6)	305 (6)	44 (6)	679 (7)
IK 383	113 (6)	130 (5)	409 (4)	79 (4)	798 (2)
Castle Cary	95 (7)	50 (8)	255 (7)	32 (7)	698 (6)
IJ 371	80 (8)	67 (7)	375 (5)	60 (5)	759 (5)
ixie Runner	—	—	506 (3)	123 (3)	780 (3)
Yandev Local	—	—	128 (8)	60 (5)	510 (8)
S.E.	±20	—	±50	—	±52

This year has again shown the superiority of Spanish 205. Natal Common has been consistently good in comparison with the long season varieties and the white skinned varieties 278-4 and 279-6 have been 3rd and 4th respectively for the last two years. The long season selection MK383 in its first introduction in 1952 gave 798 lb., kernels per annum and was second to Spanish 205. To investigate its poor subsequent showing the trial will be enlarged in 1957 incorporating more earlies together with IK383 grown at Yandev and fresh MK383 seed from Kano.

TABLE 109.—GROUNDNUT VARIETY TRIAL, GUMEL
Yields in lb. Kernels per acre

<i>Varieties</i>	1956 N.A.	1955 *** <i>Unshelled nuts</i>
IK 383	72	740
Kano 50	57	743
IK 374	56	—
Local Spreading I	53	374
Local Spreading II	36	469
S.E.	—	±46

The trial this year suffered from a low stand count caused in part by insect damage, but mostly from the late rains and their short duration. The Local Spreading II was supposed to be, as previously, Hakimin Dan Zomo but was unobtainable hence a local resembling Kano 38 was used. Local variety I was bought in Gumel market. Because of this no direct comparison between the years can be made except to note that MK383 and Kano 50 lead the list both years.

A trial at Pategi failed due to the late arrival of the rains and their short duration.

Planting Sequence Trials

These were laid out on an observational basis at eight stations, seven of which are in the Middle Belt. The long drought ensuing after the first planting rains caused in most a large gap in planting and in several cases the optimum dates seem to have been missed. In some, planting started too late to catch the ascending yields. The results are summarised in Table 110.

TABLE 110.—GROUNDNUT—PLANTING SEQUENCE TRIALS
Yields in lb. Kernels per acre

<i>Station</i>		<i>1st Planting Date</i>	<i>Last Planting Date</i>	<i>Optimum Period</i>		<i>Highest Yields</i>	
				<i>Castle Cary</i>	<i>Sp. 205</i>	<i>C.C.</i>	<i>Sp. 205</i>
Kontagora	...	7/5	25/6	7/5-6/6	9/5-16/6	(5/6) 918 lb.	(8/6) 789 lb.
Bida	... ..	10/4	18/6	?-19/5	?-21/5	10/4 343 lb.	10/4 363 lb.
Mokwa	... ..	1/5	8/8	—	—	—	—
Zonkwa	... ..	1/5	7/8	17/5-10/6	—	10/6 417 lb.	—
Shendam	... ..	19/5	13/8	23/5-8/6	19/5-6/6	4/6 999 lb.	19/5 864 lb.
Pategi	... ..	14/4	5/7	20/5-9/6	28/5-11/6	30/5 373 lb.	7/6 336 lb.
Yandev	... ..	10/4	17/7	10/4-26/4	10/4-30/4	16/4 587 lb.	28/4 680 lb.

A certain number of general conclusions can be drawn so far:—

- (1) The earlier maturing Spanish 205 is able to germinate and establish better under dry conditions.
- (2) That late plantings give a higher yield from Spanish 205 than Castle Cary (the long season type).
- (3) The optimum period in both varieties lasts an average 22 days.
- (4) Although a general peak is usually fairly clear over a given number of dates, the yields have been greatly affected by rainfall immediately before or after planting.

1. *Daura—Selection Work.*—400 progeny rows from selected plants of Daura Local Spreading were scored by eye for habit and yield per plant. Twelve were finally kept for multiplication in 1957 and subsequent trial.

A Spreading Selections trial incorporating the selections made in Daura and those sent there for observation was laid down. The Standards were Daura Local, Kano Local and Gusau upright. The yields of the top varieties were high. Results are shown in Table 111.

TABLE 111.—GROUNDNUT SPREADING SELECTIONS TRIAL, DAURA
Yields in lb. Kernels per acre

no Local	1,523	GS 531	1,015				
S 5441	1,326	Gusau Upright	987				
S 545	1,086	DS 5410	959				
S 532	1,072	AS 551	959				
S 5413	1,058	YS 553	917				
Daura Local	1,058	RS 535	903				
S 552	1,044	YS 551	846				
S 532	1,015	S.E.	±144				

It is very interesting that Kano Local should have shown up so well. Its vegetative appearance had been luxuriant.

2. *Groundnuts—Farm Garden Varieties—Daura.*—Thirty-four French varieties were again used in the farm garden in 1/40th acre plots. Yields were promising, ranging from 817 to 1,336 lb. kernels per acre, and with nineteen varieties exceeding 1,000 lb.

The Valencia group of earlies looks promising as do several of the long season spreaders and uprights. There were no plots of Daura Local in the farm garden but on the main farm in the selections trial it yielded 1,058 lb., kernels per acre and 800 lb., kernels from straight cropped blocks.

3. *Planting Sequence Trial—Daura.*—The varieties Natal Common (early maturing) and Daura Local spreading were used in this trial.

				<i>Planting Dates</i>	<i>Optimum Period</i>	<i>Peak Yields</i>
Natal Common	...	...	...	29-6-56 to 6-10-56	6.7 to 14.7	10.7
Daura Local Spreading	...	...	...	29-6-56 to 6-10-56	1.7 to 14.7	14.7

There was little difference in optimum period between the two varieties. The rains were late but once started continued steadily into September.

Kano Sub-Station—(i) New-Extension.—Approximately 130 acres of land were added to Kano farm primarily for work on groundnuts. The main operations carried out were fencing, clearing and preliminary cropping including uniformity trials. No yield trials were conducted.

(ii) Kano Multiplication Scheme.—All stages in the multiplication scheme of the groundnut variety, Kano 50, were examined for purity with satisfactory results.

Demonstration plots were laid down on a number of sites to compare the yields of Kano 50 with that of Local Spreading. Yields were as follows.

Site							Lb. kernels per acre	
							Kano 50	Local Spreading
Bichi, Dumbulum	...	...	...	...	...	...	422	326
Bichi	...	...	...	...	...	...	609	550
Babara, Giginya	...	...	...	...	...	...	738	619
Minjibir	...	...	...	...	...	...	413	394
Dawaki	...	...	...	...	...	...	354	231
Average	...	...	...	...	...	...	507	424

(iii) *Gwiwa—Kazaure Emirate.*—Uprights were found growing on two farms at Gwiwa. Samples were collected on 1/40th acre plots arranged in one of the farms and in adjacent farms growing local spreading.

Yields of Sample Plots

							Plot	Yield Kernels lb. per acre	Shell per cent
Uprights	...	...	...	...	...	...	1	588	64
							2	531	64
							3	620	73
Spreaders	...	...	...	...	...	...	1	292	68
							2	197	67
							3	158	72

The upright seed had been obtained two or three years ago from Roni demonstration farm and could be either Kano 50 or Castle Cary. Samples were taken.

(iv) *Stock Plots and Introductions.*—All existing stock plots and new introductions were scored for habit and pod and kernel characteristics. They were then, as far as possible, classified into the groups used by A. H. Bunting. All the early maturing varieties fell easily into their prescribed groups. The long season uprights were more difficult. Within the flesh testa group the only reliable divisions were those with typically two-seeded pods, three-seeded pods and jumbo type. This left the bulk of varieties in the two-seeded pod class. In this class there was variation in pod size, beak and degree of constriction. With the scoring system used the differences were not sufficiently marked or consistent to give any reliable division. Habit in the field was also scored and measured but there were little or no varietal differences.

The long season spreaders presented the same problem. After testa colour and jumbo type pods had been used to classify some of the varieties, the bulk remained as flesh testa and two-seeded pods. A tentative division was made on pod size.

Kano Trials Main Farm

The main and second variety trials were sited on the old farm together with two Botanist selections trials.

TABLE 112.—GROUNDNUT MAIN VARIETY TRIAL
Yields in lb. Kernels per acre

<i>Variety</i>	1956	1955	1954	1953
	**	***	**	***
MK 374	1,404	758	837	1,227
Kano 50	1,393	710	845	1,064
MK 383	1,234	808	941	1,261
ML 372	1,197	773	—	—
MG 371	1,139	821	—	—
Kano Local Spreading	1,021	572	444	874
MH 382	961	—	—	—
S.E.	±89	±39	±52	±50

The top varieties retained their positions and yields were high. For the last three years of the trial there have been no significant differences between the top varieties Kano 50, MK374, MK383 and ML372. Only in 1953 has Kano 50 been significantly outyielded by MK383 at the 1 per cent level and by MK 374 at the 5 per cent level. Kano 50 has outyielded the local spreading at the 1%, 5%, 1% and 5% levels respectively over the past four years. Dixie Runner was dropped from the trial after 1955 and MK 382 which had been used in Daura was put in.

In the Second Variety Trial there were no significant differences and all varieties gave good yields. The order of finishing has not been consistent except in the case of L 234 which has been low in all three years. Under Kano conditions there would appear to be no difference in the yielding potential of these varieties.

TABLE 113.—GROUNDNUT SECOND VARIETY TRIAL
Yields in lb. Kernels per acre

	1956 N.S.	1955 N.S.	1954 N.S.
Kano 38	1,228 (1)	890 (9)	791 (4)
Samaru 38	1,216 (2)	996 (3)	583 (9)
L 60	1,195 (3)	1,027 (1)	762 (6)
Kano 50	1,172 (4)	992 (4)	807 (3)
L 245	1,149 (5)	967 (6)	791 (4)
L 260	1,128 (6)	1,001 (2)	742 (7)
L 235	1,109 (7)	982 (5)	883 (1)
L 250	1,103 (8)	959 (7)	838 (2)
L 234	1,053 (9)	897 (8)	701 (8)
S.E.	±86	±52	±60

3. *Groundnut Upright Selections Trial.*—All upright selections made in Kano and those sent there for observation were put into this trial. Kano 50 and Kano 38 were used as the standards.

TABLE 114.—GROUNDNUT UPRIGHT SELECTIONS TRIAL
Yields in lb. Kernels per acre

<i>Variety</i>	<i>Yield</i>	<i>Variety</i>	<i>Yield</i>	<i>Variety</i>	<i>Yield</i>
KLM 162 ...	1,141	Kano 50 ...	1,063	KLM 144 ...	1,014
EM 541 ...	1,117	Kano 38 ...	1,049	MU 538 ...	1,013
RU 544 ...	1,091	KLM 139 ...	1,045	KLM 3 ...	1,010
KLM 175 ...	1,089	MU 537 ...	1,038	WU 535 ...	1,008
KLM 49 ...	1,083	KLM 164 ...	1,027	KLM 141 ...	987
WU 5310 ...	1,071	MU 535 ...	1,016	MU 536 ...	972
KLM 128 ...	1,071	MU 539 ...	1,016	KLM 83 ...	937
				S.E. ...	±150

There were no significant differences. The yields are reasonable.

KLM 175 is distinguishable from the others by having characteristically three-seeded pods.

4. *Groundnut Spreading Selections Trial.*—All spreading selections made in Kano and those sent there for observation were put into this trial. Unselected Kano Local Spreading, Kano 50 and unselected local Bagwaria from Bichi were used as the standards. The Bagwaria had only a few plants of jumbo-type.

TABLE 115.—GROUNDNUT SPREADING SELECTIONS TRIAL
Yields in lb. Kernels per acre

MS 539 ...	...	...	...	1,389	KLS 191 ...	...	...	...	1,223
DS 549 ...	...	...	...	1,359	DS 5414 ...	...	...	...	1,222
MS 541 ...	...	...	...	1,257	DS 5417 ...	...	...	...	1,217
KLS 133 ...	...	...	...	1,336	GS 534 ...	...	...	...	1,215
DS 5421 ...	...	...	...	1,324	KLS 47 ...	...	...	...	1,197
Kano 50 ...	...	...	...	1,306	KLS 139 ...	...	...	...	1,110
Bagwaria ...	...	...	...	1,292	KLS ...	...	...	...	1,068
MS 535 ...	...	...	...	1,260					
					S.E. ...	...	...	...	±65

As seen in the table most of the varieties significantly outyielded local spreading. It is of interest that the local Bagwaria was not significantly outyielded.

New Selections:

(i) Twenty-four upright selections were collected in the Babura sowing area. This is north of the present Kano 50 distribution area.

(ii) Samples of upright types were collected near Birniwa in Hadejia Emirate. It seems likely that these are survivors from Samaru 38 which had been distributed some time ago by the Native Authority.

EARLY MILLET

(Pennisetum typhoides)

Two sets of material were discarded this season; the early maturing selections became mixed through outcrossing while the early maturing hybrids failed to show any superiority over unselected material.

2. *Selfed Selections*.—These selections are of the same origin as the discarded material. In 1956 selfing was continued and seventy-two inbred lines were selected. These lines have been inbred for six generations and are relatively uniform for most plant and grain characters. The seventy-two lines will be tested for combining ability with a view to producing a synthetic bulk.

3. *Selfed Selections*.—A further 108 selections made from a mixed bulk were selfed. These in turn will be converted into inbred lines which will be tested for combining ability.

4. *Millet Uniform Nursery*.—A collection of ninety-one varieties was grown at Samaru for observation. Attempts were made to sib-cross each line but the labour involved was too great and fresh introductions will have to be made in 1957.

LATE MILLET

(Pennisetum maiwa)

(1) “*Maiwa*”—“*Dauro*” Trial.—In some provinces “maiwa” and “dauro” are regarded as two distinct crops. In other provinces no distinctions are made. This trial consisted of a series of replicated observation plots. Ten varieties of “maiwa” and “dauro” were grown. Each variety was sown (a) direct and (b) transplanted in June and late July.

Observations were recorded on twelve vegetative features and on several field characters, but it was not possible to distinguish between “maiwa” and “dauro” on this basis. The botanical status of the two crops is thus not yet clear, but these observations lend support to the supposition that the general difference between maiwa and dauro is one of method of cultivation rather than of species or variety. (See Appendix III).

SORGHUM
(*S. vulgare*)

1. *Local Varieties*.—This part of the programme is directed towards the production of improved strains of a relatively few standard varieties.

Local variety trials at outstations began in 1954 with a view to finding out:—

- (a) Which varieties yielded reasonably well over a large area, and
- (b) Which varieties would be accepted over large areas.

Results from these trials in 1956 tended to confirm the previous year's work. The results are given in Table 116.

TABLE 116.—YIELDS IN LB. THRESHED GRAIN PER ACRE—*continued*

Variety	Origin	STATION							
		Kano				Samaru			
		54	54	55	56	54	55	56	
<i>Significance of Trial:</i>									
1. Shambul ...	Maiduguri ...		***		***				***
2. Farar-Kaura ...	Daura ...		355	433	206	15	352		747
3. Farafara ...	Gusau ...		573	496	232	35	19		1,595
4. Yan Gurki ...	Kano ...		331	392	191	47	31		1,562
5. F. C. Standard ...	Kano ...	2,208	367	493	453	21	29		1,563
6. Short Kaura ...	Gusau ...		367	347	318	31	22		
7. Ladore ...	U.S.A. ...		36			7			
8. T 50-97 ...	French Niger ...								
9. T 50-5 ...	French Niger ...								
10. T. Congossam ...	French Niger ...								
11. T 50-88 ...	French Niger ...								
12. T. Laba Rakoumi ...	French Niger ...								
13. T 50-3 ...	French Niger ...								
14. Buturi Huta ...	Kano ...				251				
15. Tall Kaura ...	Kano ...	2,177		396				1,503	
16. Kaura Broomhead ...	Kano ...	2,177						1,445	
17. Farafara (Compact) ...	Kano ...	1,983						1,262	
18. Gwoza Local ...	Gwoza ...								
19. Jaddawa ...	Sokoto ...								
20. Janjare ...	Sokoto ...								
21. Light Mori ...	Samaru ...						26		2,050
	S.E.± ...	160	45	113	27			75	183

TABLE 116.—YIELDS IN LB. THRESHED GRAIN PER ACRE—*continued*

Variety	Origin	Station							
		Ilorin		Yandev				Bauchi	Yola
		55	56	54	55	55	56		
<i>Significance of Trial:</i>									
22. Kaura ...	Bauchi ...	...	***	***	***	***	***	***	***
23. Farafara ...	Samaru ...	...	†	...	...	...	...	...	...
24. Farafara ...	Kontagora ...	...	607	1,089	708	408	458	679	458
25. Kaura ...	Samaru ...	...	662	618	634	475	357	458	350
26. Janare ...	Zonkwa ...	...	504	510	668	342	438	164	164
27. Akuki ...	Yandev ...	...	640	705	328	284	117	143	117
28. Agyan ...	Zonkwa ...	...	155	466	306	168	153	3	3
29. Y.M. 548 ...	Yola ...	...	...	313	313	228	302	...	1,047
30. Local ...	Yola ...	...	...	...	...	...	...	...	846
31. Y.M. 148 ...	Yola ...	...	...	...	...	...	...	...	834
32. Blackglumed Farafara ...	Zonkwa ...	...	...	...	...	...	...	...	678
33. Whiteglumed Mori ...	Zonkwa ...	...	...	...	...	...	...	...	633
34. Yandev Red ...	Yandev ...	...	...	...	...	...	...	...	...
35. Ilorin Red ...	Ilorin ...	722	383	...	...	...	...	...	...
36. Yongoatsuwe ...	Nbayion ...	29	41	32	44	61	278	51	48
	S.E. †						35		

† Interplanted through maize.

‡ Interplanted through early millet.

SOYA BEANS
(*Glycine max*)

Interest in Soya Beans is increasing in the Middle Belt area and Production in Niger Province has increased steadily. Purchases in Niger Province exceeded those of groundnuts for the first time in the 1956-57 season.

The experimental programme in 1956 consisted of variety trials at Samaru, Ilorin, Yandev, Mokwa, Riyom and Kontagora. Experiments designed to determine the effectiveness of seed inoculating bacteria were carried out at Samaru, Ilorin and Kontagora. A series of observational trials on dates of planting was run at Samaru, Kontagora, Yandev and Ilorin.

At Samaru a collection of forty-five varieties was maintained and work progressed on pedigree selection within some of the varieties. Mass selection was practised on all varieties to form a nucleus of pure seed.

Variety Trials.—The yields obtained in the 1956 Variety Trials are shown in Table 117.

TABLE 117.—REGIONAL SOYA BEAN VARIETY TRIALS
Yields in lb. Threshed Beans per acre

Variety	Samaru	Ilorin	Yandev	Kontagora	Mokwa	Riyom
	***	***	***	***	N.S.	N.A.
Misc. 9H	954 (2)		410 (2)	927 (2)	825 (1)	109 (1)
Bilomi No. 3	870 (6)	890 (2)	417 (1)	946 (1)	718 (2)	87 (2)
Black Matted Java	982 (1)			878 (3)		85 (3)
28 E.B.	891 (4)	640 (5)		612 (6)		17 (5)
Malayan	740 (12)	890 (2)	362 (3)	632 (4)	667 (3)	10 (8)
Pero Yellow		938 (1)				
Head Green	939 (3)		346 (5)			
Belofield No. 1	873 (5)					
Benares	822 (7)	763 (4)	344 (6)	601 (7)	650 (4)	16 (6)
Avoyelles	802 (8)				612 (6)	
No. 459	798 (9)	366 (7)	359 (4)			
Lawol	797 (10)					
No. 27	783 (11)	863 (3)				
Bilomi No. 1	738 (13)		286 (8)	535 (9)	636 (5)	7 (9)
Chame	515 (14)	308 (8)			487 (7)	
Yellow Bermelly	416 (15)		225 (9)	626 (5)	487 (7)	59 (4)
Fort Lamy		596 (6)				
Dixie				584 (8)		13 (7)
Mokolo			342 (7)			
S.E.	±67	±57	±22	±65	±85	

The performances of the varieties Miso. 94, Bilomi No. 3 and Black Matted Java has been good in all trials. It is unfortunate that these strains

are all black-seeded. Present policy calls for the replacement of all black-seeded types with yellow-seeded varieties. Among the yellow-seeded varieties Malayan is recommended for Ilorin, Yandev and Mokwa areas while Yellow Bermelly and Malayan are suitable for Kontagora. No recommendation can be made for the Plateau at present.

The 1956 results at Riyom were disappointingly low. When the trial was first run in 1952, the yields were satisfactory and it is possible that results in 1956 are poor due to late harvesting after most of the seed had shattered.

Soya Bean Variety Trial—Samaru.—Fifteen varieties were tested at Samaru in 1956 in a balanced incomplete block experiment. The results are shown in Table 118, together with those of previous years.

TABLE 118.—SOYA BEAN VARIETY TRIAL, SAMARU
Yields in lb. Threshed Beans per acre

<i>Variety</i>	1949	1950	1951	1952	1954	1955	1956	<i>Average</i>
	***	**	***	N.S.	*	N.S.	***	
Black Matted Java ...	—	—	983	974	709	515	1,082	853
Misc. 94 ...	—	—	1,088	1,154	819	813	954	966
Head Green ...	—	—	—	—	—	—	939	(939)
28 E.B. ...	—	—	—	980	706	708	891	821
Belofield No. 1 ...	—	—	—	—	—	—	873	(873)
Bilomi No. 3 ...	—	—	1,184	1,174	946	834	870	1,002
Benares ...	1,079	963	846	986	824	830	822	907
Avoyelles ...	1,102	823	—	—	—	—	802	909
No. 459 ...	—	—	—	—	—	—	798	(798)
Lawoe ...	—	—	—	—	—	—	797	(797)
No. 27 ...	—	—	—	—	—	—	783	(783)
Malayan ...	1,032	—	—	1,038	601	674	740	817
Bilomi No. 1 ...	—	—	1,021	1,048	508	732	738	809
Chame ...	—	—	—	—	—	—	515	(515)
Yellow Bermelly ...	—	—	798	1,159	813	518	416	541
S.E. ...	±33	±65	±50	±264	±80	±100	±67	

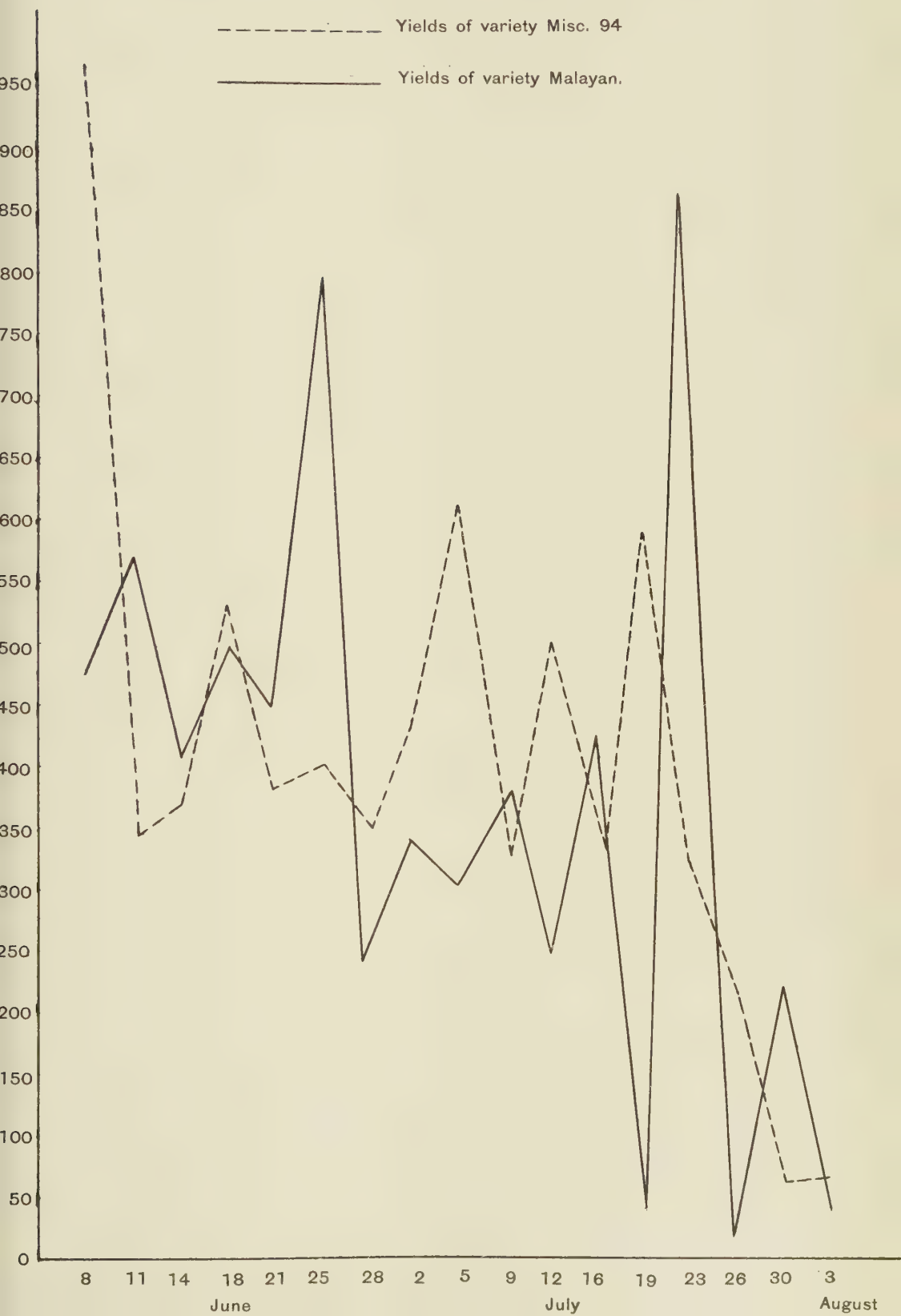
The highest yielding varieties over a period of years are Bilomi No. 3 and Misc. 94. These varieties are black-seeded and cannot therefore be recommended.

Soya Bean Planting Sequences.—Four observational trials were run in 1956. These were located at Samaru, Kontagora, Ilorin and Yandev. The results obtained in 1956 were not conclusive at Samaru and, if possible, earlier planting should be done in 1957.

The Kontagora trial was planted daily and does not cover a sufficiently large period. On the basis of the present results, however, the third week in June appears to be the most suitable time for planting Soya Beans.

Figure 4

Soya Bean Planting Sequence Trial, Samaru.



At Ilorin, once again, the period should have started sooner. The first planting being done in early May. The present results indicate that during the first three weeks of June is satisfactory.

Effect of Nodule Bacteria on Soya Beans.—Observational trials carried out some years ago indicated that a local strain or strains of nodule bacteria, effective on soya beans, is general in the region. To check this point full scale trials were laid down using imported soya bean inoculant. Results of the trials are presented in Table 119.

TABLE 119.—SOYA BEAN INOCULATION TRIALS

Yields in lb. Threshed Beans per acre

Variety	Samaru	Ilorin	Kontagora		Average
	Malayan	Malayan	Malayan	Yellow Bermelly	
Inoculated	N.A. 458	N.S. 385	N.S. 624	N.S. 677	536
Non-inoculated	480	450	598	635	541
S.E.	—	±61	±64	±50	

The results of these trials support the belief that a local nodule bacteria is present which is effective on Soya Beans, or else the inoculum had deteriorated.

BENNISEED

(Sesamum indicum)

The work in Benniseed is done mostly at Yandev in Benue Province. In 1956 the selection programme continued but due to a particularly poor year for this crop, the programme did not progress as well as was hoped. Yields were extremely low and made the selection of suitable plants difficult. Late planted benniseed was severely attacked by gall wasps and in some fields practically every seed pod turned into a gall. Mildew and wilt were also present but their effects were limited at Yandev.

Hybridization was begun at Samaru and a successful crossing technique was quickly developed. The hybridization programme was limited in the first instance to material available at the time but will, in future, concentrate on the development of a suitable local non-shattering strain. Over 500 crosses were made for planting in 1957.

The distribution in Benue Province of the Botanist's high-yielding selection, now known as Yandev 55, has met with success.

SUGAR CANE
(*Saccharum officinale*)

Multiplication of introduced varieties of sugar cane said to be resistant to Red Rot Disease has continued. Sets have now been sent to Kano, Sokoto, Bauchi, Katsina, Ilorin, Plateau and Zaria Provinces. A shipment was also made to the Eastern Region. Altogether almost 13,000 canes of 11 varieties have been sent out.

Effect of Gammexane in controlling termite attack on cuttings.—Three methods of planting were used, i.e. (1) canes laid horizontally and buried, (2) canes deep-planted, (3) canes shallow-planted. Two methods of applying gammexane powder (.65 Gamma BHC) were tried, (1) gammexane dusted on the soil and (2) gammexane applied to cuttings.

The results of this test show that both methods of application of gammexane powder are satisfactory, but that this insecticide tends to inhibit the growth of the cane. Treated canes were much slower than controls in producing shoots and the ones that did germinate produced stunted shoots.

Sugar Cane Variety Trial—Maigana.—This experiment compared the yields of cane, juice and sugar per acre of six introduced and one local variety. The introduced canes are all of the hard' type while the local is a soft chewing type. Results are presented in Table 120.

TABLE 120.—SUGAR CANE VARIETY TRIAL—MAIGANA, 1956

Variety	Cane in tons per acre	Juice in cwt. per acre	Sucrose in cwt. per acre
	***	*	N.S.
NCO 310	11.19	116.1	16.5
CO 301	15.91	110.3	16.2
CO 213	14.12	105.3	16.1
POJ 2725	10.28	86.6	11.5
CO 331	11.51	83.5	12.4
CO 281	9.35	69.1	12.4
Local	7.07	65.3	8.5
S.E.	±1.47	±12.5	±2.3

Cane yields of three imported varieties are significantly higher than the local cane. When juice yields are considered two of the same varieties are again better than local and a third, CO 213 replaces CO 331.

There are no significant differences in the yield of sucrose but the yields of NCO 310, CO 301 and CO 213 approach significance.

TOBACCO

(*Nicotiana tabacum*)

Tobacco Variety Trial—Samaru.—After consultation with the Nigeria Tobacco Company it was decided to curtail the previous series of variety

rials as it contained types which are of no interest to the Company (the Nigerian Tobacco Company being the only large buyer of tobacco).

Four new varieties were obtained by the Nigeria Tobacco Company from the U.S.A., and tested in 1956 against Virginia Hybrid (the standard variety in the North) and Cash (one of our better performers in recent years).

The season was not altogether favourable to tobacco at Samaru due to the early cessation of the rains. Yields of cured leaf were not as high as in the previous two years but were, nevertheless, much better than local farmers' yields which, according to the Nigeria Tobacco Company, are in the neighbourhood of 300 lb., per acre.

The results obtained in 1956 are shown in Table 121, together with results of previous experiments.

TABLE 121.—TOBACCO VARIETY TRIAL, SAMARU
Yields in lb. Cured Leaf per acre

<i>Variety</i>	1956	1955	1954
	*	***	**
Mockers 144	632	—	—
Virginia Hybrid	595	432	588
Belcrest	568		
ixie Bright 244	506		
icks	493		
ash	385	682	731
old Dollar	—	754	803
arrison Special	—	661	762
amaica Wrapper		653	667
ellow Mammoth		642	634
ynner		626	654
Improved one Sucker		537	509
izard Tail Orinoco No. 2		390	497
ittle Crittendon No. 5		381	520
heavy Western		250	590
S.E.	±51	±51	±60

In 1956 Virginia Hybrid and the four new varieties all produced significantly higher yields than Cash. The trial is being repeated in 1957.

SUNFLOWER

(Helianthus annuus)

Sunflower Topping Trial.—This experiment was carried out at Samaru to determine the effect of Topping Sunflower plants on yield. Topping was done on 26th October, 1956 and 2nd November, 1956. The results were in favour of the control which gave a yield of 480 lb. of threshed seed per acre. The two Topping treatments produced 147 and 133 lb. respectively. A clear indication that Topping at these particular dates has a deleterious effect on yields of Sunflower.

RAMA

(Hibiscus cannabinus)

Planting Sequence Trial.—An experiment was conducted on eight varieties of Rama to determine the optimum date of planting for fibre production. Twenty-nine planting dates were used ranging from 5th June to 31st July. The plants were harvested on 17th and 18th December, retted in a large water tank and yields of dry fibre recorded.

The results are shown in Table 122 and in Figure 4. The average yields of the eight varieties over the twenty-nine planting dates are shown against the daily rainfall figures in graphical form.

SAFFLOWER

(Carthamus tinctorius)

Safflower Planting Sequence, Samaru.—Previous experience at Samaru indicated that late planting of Safflower tends to produce higher yields than early planting. This planting sequence was laid down to determine the optimum time for late planting.

Plantings were made at three-day intervals, starting on 1st August and continuing until 29th September.

Results are shown in graphical form in Figure 5. Yields in lb. of threshed seed per acre and stand counts are plotted against dates of planting.

It can be seen that there is a steady decline in yields after the September 17th planting. The planting on August 17th gave the highest yield but was preceded by low yields after the first planting. There is some correlation between yields and stand count in the later plantings.

TABLE 122.—RAMA PLANTING SEQUENCE, SAMARU

Yields in lb. dry Fibre per acre

Planting Date	Varieties								Average
	Brazi- lian	Local Green	Sudan 2	Egypt- ian	Local Red	San Salvador	Sudan 1	Egypt- ian	
5-6-56 ...	278	468	177	173	274	125	85	89	208
7-6-56 ...	133	327	125	65	258	141	258	—	163
9-6-56 ...	28	28	56	69	—	24	73	234	64
1-6-56 ...	302	262	262	89	117	323	60	476	236
3-6-56 ...	343	544	157	270	621	101	520	173	341
5-6-56 ...	355	649	153	97	145	202	307	327	254
7-6-56 ...	48	28	85	186	40	28	129	105	81
9-6-56 ...	294	218	40	190	339	327	468	323	275
1-6-56 ...	173	190	520	69	173	403	173	290	248
3-6-56 ...	—	56	190	65	65	16	65	125	73
5-6-56 ...	129	—	161	16	65	77	97	177	90
7-6-56 ...	149	226	73	20	—	40	56	113	85
9-6-56 ...	48	85	181	121	28	52	24	85	78
1-7-56 ...	40	93	117	20	44	40	129	24	63
3-7-56 ...	210	137	177	69	77	177	97	331	159
5-7-56 ...	190	270	496	77	89	315	403	553	299
7-7-56 ...	222	254	391	145	266	270	367	520	304
9-6-56 ...	153	93	355	65	186	105	266	218	180
1-7-56 ...	177	250	278	141	230	270	262	327	246
3-7-56 ...	117	81	290	16	36	117	250	77	123
5-7-56 ...	36	121	48	60	69	60	137	190	90
7-7-56 ...	206	218	294	367	145	202	302	331	258
9-7-56 ...	238	423	194	553	391	379	206	391	347
1-7-56 ...	254	153	149	238	177	210	290	262	217
3-7-56 ...	153	177	125	278	117	133	218	210	176
5-7-56 ...	77	93	44	73	109	56	125	73	81
7-7-56 ...	81	153	16	81	81	40	133	89	74
9-7-56 ...	36	40	32	93	24	24	56	89	49
1-7-56 ...	137	93	137	202	238	28	173	246	157
Average Yield	159	197	178	134	157	148	198	222	

Figure 5

Rama Planting Sequence. Samaru.

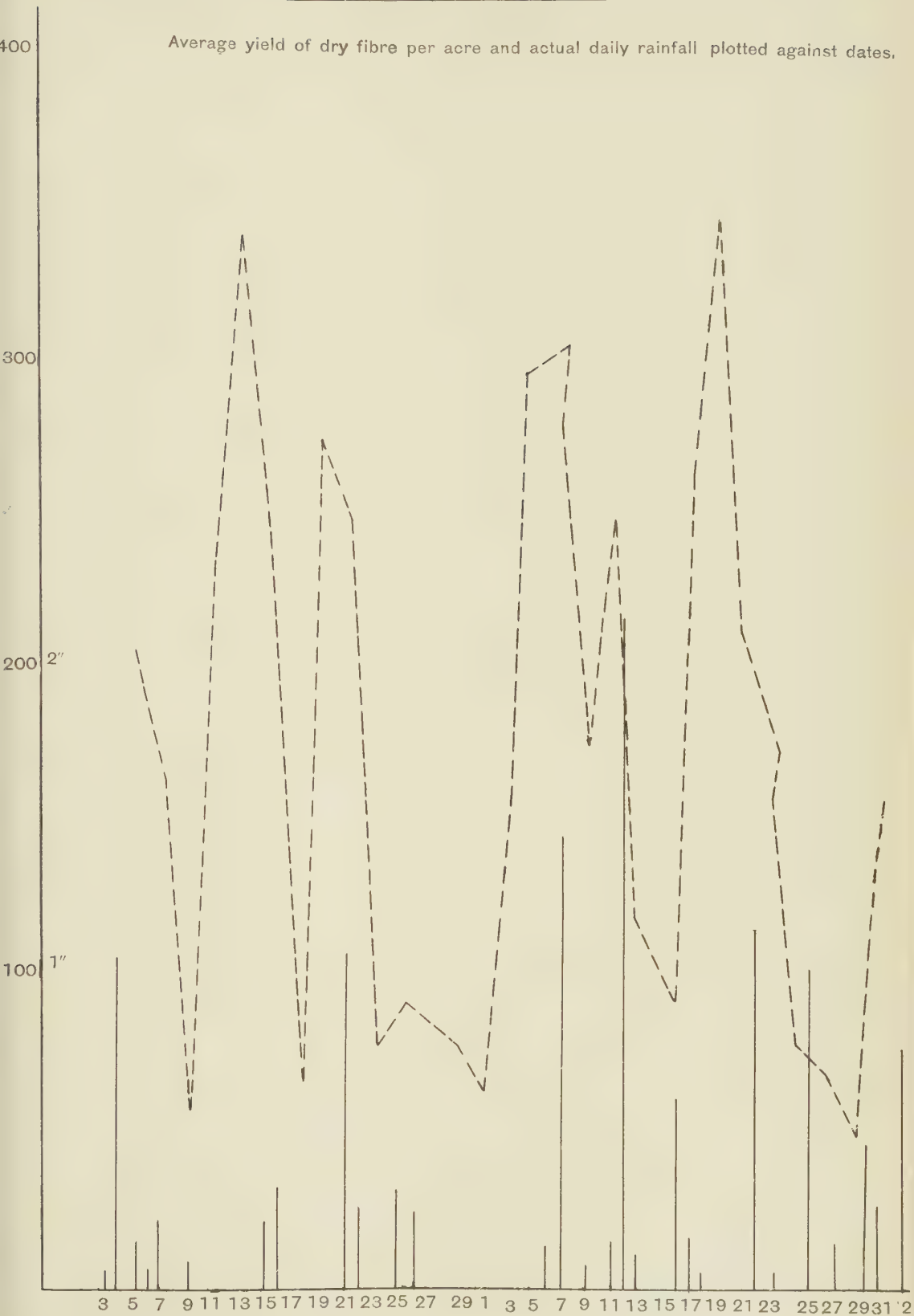
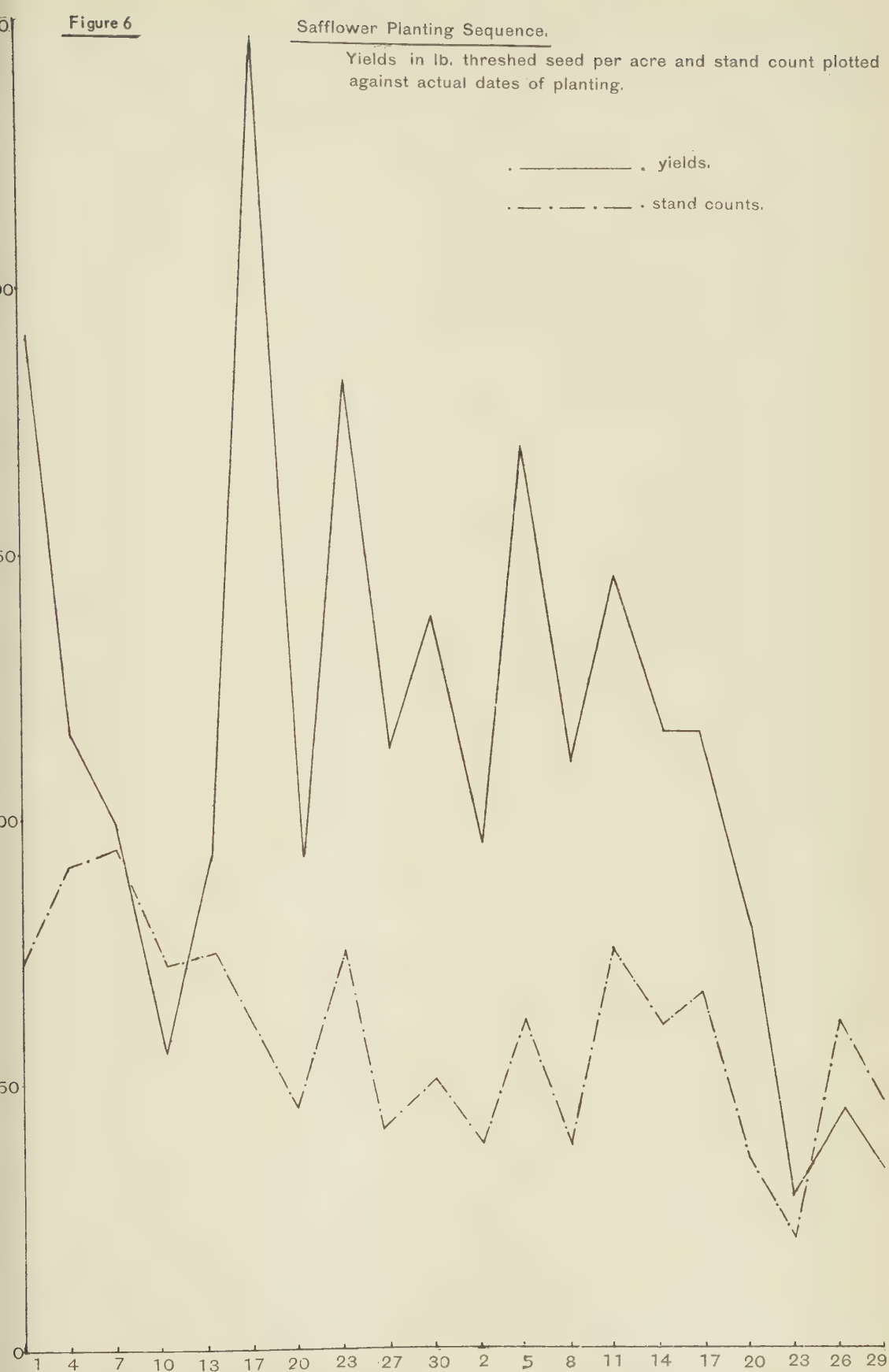


Figure 6

Safflower Planting Sequence.

Yields in lb. threshed seed per acre and stand count plotted against actual dates of planting.

— yields.
- . - . - . stand counts.



COWPEAS
(*Vigna sinensis*)

Although the yield per acre of this crop is very low the total production is large and it is of importance both for local consumption and for internal trade. Quality is of greater importance than yield, and introduced high yielding varieties have not been accepted because of coloured seed coats and hard flesh.

In 1956 a more intensive study of cowpeas was started. As a first step 100 varieties and strains of cowpeas collected from many countries were planted for observation. These varieties can be divided into two main groups, day neutral and short day*.

Almost all the varieties collected in Nigeria fall into the short day group. These varieties are planted between mid-July and the end of August, and do not begin blooming before the end of September and the early part of October. As happened last year, this late planting date means that in years when the rains cease early this crop can easily be a failure. If these short day varieties are planted before the middle of July they usually produce little or no seed. Instead they continue to grow vegetatively, even when the days are short enough to stimulate flower formation.

The majority of the varieties introduced from abroad fall into the day neutral group. It appears best to plant this group of varieties early in the season for they will produce seed throughout the growing season. On the other hand, they appear to be much more drought resistant than the local varieties, and will produce seed far into the dry season. This ability to produce seed over such an extended period probably contributes to the ability of these introduced varieties to outyield the local short day types. It also means that these day neutral varieties are capable of giving a good crop even when the rains stop early. However, as stated earlier, these varieties are not acceptable because they have coloured seed coats and hard flesh. In addition, the farmer holds it a disadvantage that these varieties produce much of their seed during the rains, when it is difficult to dry the seed properly.

The variety then which we need to find or develop appears to be a high yielding (probably day neutral) white, soft seeded type. It was hoped to produce such a variety by backcrossing one with a white seed coat onto a day neutral variety with a high yield. Unfortunately, from the crosses that have been made, it appears that white seed coat is not inherited simply. However, the original crosses are being planted out and promising plants are being selected for further trial.

*Work at Ibadan by Dr. E. Njoku indicates that the local Ibadan short day varieties will flower with a day length of 12 hours but not with one of 12 hours and 15 minutes.

CASSAVA

(Manihot utilissima and M. palmata)

1. *Cassava Mosaic Yield Trial*.—This experiment is part of a series of trials begun in 1948 to determine the effect of mosaic on yield. The 1951 and 1954 trials were failures due to an attack of *Fusarium equiseti*. Table 124 shows the results of this trial.

TABLE 123.—CASSAVA MOSAIC YIELD TRIAL
Yields in lb. of Roots per acre

<i>Treatment</i>	1948	1950	1951	1952	1953 1954	N.S.	<i>Average</i>
Clean Samaru Dan Warri	**	N.S.	N.S.	N.S.		N.S.	—
Infected Samaru Dan Warri ...	10,390	11,873	12,294	8,966	Failed	9,602	10,625
Infected Zonkwa Dan Warri ...	—	10,959	11,005	10,854	Failed	9,115	10,483
	7,020	12,849	12,633	9,114	Failed	10,779	10,479
S.E. ...	±135	±371	±875	±612		±1,040	—
1% Sig. diff. ...	2,101	—	—	—			—

This table shows that 1948 trial has been the only one where there was a significant difference between treatments. However it is obvious that the lower yield of the infected Dan Warri may be due to a difference in the original clones which came from Zonkwa and Samaru respectively. Therefore beginning in 1950, infected plants of the originally "clean" Samaru Dan Warri were included in the trial to give the treatment Infected Samaru Dan Warri. Since then, each successive trial has shown more convincingly that there appears to be no significant difference between the three treatments; the 1955 results again show no difference between the treatments. It would appear from these results that under the conditions at Samaru, mosaic does not have a depressing effect on the yield of the variety Samaru Dan Warri.

2. *Cassava Clones Yield Trial*—In 1950 eleven promising clones were selected for trial from thirty-seven clones which were started in 1948 from open pollinated seed. Code letters of the female parents of these clones are as follows:

A—Maiduguri Dan Warri

B—Ibadan GC 997 B

C—Ibadan C/36/95

E—Ibadan CH 28

H—Minna GC 997 B.

TABLE 124.—CASSAVA CLONES YIELD TRIAL
Yields in lb. or Roots per acre

Variety or Clone		1950	1951	1952	1953	1954	1955	Average
CH 50	...	** 13,407 (1)	** 19,219 (2)	** 7,783 (2)	** 5,766 (4)	†	** 10,969 (2)	11,429
B 18	...	10,959 (5)	17,451 (3)	7,068 (4)	5,901 (3)	†	11,063 (1)	10,488
E 2	...	12,944 (3)	13,807 (6)	8,032 (1)	7,483 (1)	†	9,613 (5)	10,376
Dan Warri	...	8,857 (8)	19,421 (1)	6,798 (5)	4,571 (7)	†	9,830 (4)	9,895
C 15	...	13,309 (2)	13,161 (8)	5,888 (6)	3,896 (8)	†	7,269 (11)	8,705
Two Cent	...	10,794 (6)	13,398 (7)	4,390 (11)	5,911 (2)	†	7,538 (9)	8,406
B 17	...	12,715 (4)	12,678 (9)	4,191 (13)	3,471 (10)	†	7,798 (8)	8,171
CH 28	...	8,519 (9)	11,504 (10)	5,715 (7)	4,696 (6)	†	7,976 (6)	7,682
C 5	...	9,843 (7)	14,828 (5)	4,424 (10)	2,179 (14)	†	6,972 (13)	7,649
H 1	...	6,001 (11)	15,193 (4)	4,858 (8)	3,780 (9)	†	7,510 (10)	7,468
C 23	...	3,011 (13)	11,386 (11)	7,045 (3)	4,976 (5)	†	7,817 (7)	6,847
B 21	...	8,107 (10)	7,323 (13)	1,890 (15)	2,073 (15)	†	10,640 (3)	6,007
B 26	...	—	7,480 (12)	4,306 (12)	3,356 (11)	†	7,218 (12)	5,590
A 2	...	—	5,428 (14)	4,478 (9)	3,095 (12)	†	6,492 (14)	4,873
B 9	...	55,000 (12)	4,593 (15)	3,602 (14)	2,526 (13)	†	6,262 (15)	4,396
S.E.	...	±1,682	±5,428	±714	±181	†	—985	—

† Crop not harvested because of an attack of *Fusarium equiseti*.

As a result of the 1955 trial, there have only been three changes of one position in the average yield of the clones of the five trials, 1950 to 1955 compared to the average of the four trials 1950 to 1953. These varieties are E 2 with B 18, CH 28 with C 5 and B 21 with B 26. The only variety to give a marked difference in yield from the average was B 21, which came third this year, but as already stated this changed its average yield very slightly in comparison with the other clones.

In the 1956 trial the three selections A 2, B 9 and B 21 have been omitted because of their consistently poor yields. The results of this 1956 trial cannot be reported until next year as our cassava is not harvested until after this report has been written.

It is interesting to note that E 2 is giving a much higher average yield than its female parent CH 28, while A 2 is giving a much lower yield than its female parent Dan Warri.

3. *Investigations on bitterness, HCN content and palatability of Cassava Roots.*—Palatability of cassava roots seems to be associated with their bitterness and this bitterness is believed to be due to the presence of HCN in the roots.

Last year the Chemist analysed the roots of fourteen clones of cassava for the amount of HCN liberated from the skin, phelloderm and flesh using steam distillation. The results are given in Table 126.

TABLE 125.—HCN CONTENT OF CASSAVA ROOTS
HCN content given in mg/kg of fresh material

Variety								Skin	Phelloderm	Flesh
A 2	...	...	...	...	...	...	...	Nil	130	70
B 9	...	...	...	...	...	...	...	Nil	326	243
B 17	...	...	...	...	...	...	...	Nil	438	5
B 18	...	...	...	...	...	...	...	Nil	419	132
B 21	...	...	...	...	...	...	...	Nil	Nil	Nil
B 26	...	...	...	...	...	...	...	Nil	397	162
C 15	...	...	...	...	...	...	...	Nil	Nil	Nil
C 23	...	...	...	...	...	...	...	Nil	327	47
CH 28	...	...	...	...	...	...	...	Nil	108	8
CH 50	...	...	...	...	...	...	...	Nil	146	Nil
E 2	...	...	...	...	...	...	...	Nil	Nil	Nil
H 1	...	...	...	...	...	...	...	Nil	189	65
Dan Warri	...	...	...	...	...	...	...	Nil	216	11
Two Cents	...	...	...	...	...	...	...	Nil	292	57

It can be seen that the HCN is much more concentrated in the phelloderm than in the flesh, while there is none in the skin.

A few authors state that 'bitter' varieties, i.e. those with a high HCN content, tend to outyield 'sweet' varieties, i.e. those with a low HCN content. Our results do not appear to support this statement at all, for the show no relation between yield and HCN content (see Figure 6).

Figure 7

Yield of Cassava Roots Related to HCN Content

The yield of cassava roots shown by the line graph is the average of the Clones Yield Trials for the years 1950 to 1955. The HCN content shown by the bars was determined during June, 1956.



Toxicity of Cassava.—There has been considerable work done in the past on the toxicity of cassava roots. (G. G. Bolhuis, "The Toxicity of Cassava Roots." Netherlands Journal of Agric. Sci. 2: 6-13, 1954). This toxicity is apparently due to the presence of a glucoside, linamaria, which when acted on by the enzyme linase, releases highly poisonous prussic acid (HCN). Investigators have calculated that 50-60 mg of HCN is the lethal dose for a man weighing 50 kg. and with this information have drawn up the following system of classification for peeled cassava roots.

Less than 50 mg HCN per kg. fresh roots—Innocuous.

50-100 mg HCN per kg. fresh roots—Moderately poisonous to poisonous.

More than 100 mg HCN per kg. fresh roots—Very poisonous.

Using this classification, it can be seen that three of the varieties, B 9, B 18, and B 26, analysed by the Chemist are very poisonous. Although it is believed that all the HCN is driven off if the roots are properly prepared, it would still appear to be dangerous to release varieties having roots with such a high HCN content, as the roots may not be properly prepared or may even be eaten raw. This matter is being investigated further.

Last year our 36 clones were made into gari and these gari samples were tested for palatability. Poor technique made this test of questionable value. Even so, there seemed to be some association between flavour and HCN content. Seed from open-pollinated flowers has been collected to start new clones.

SWEET POTATO

(*Ipomoea Batatas*)

Because of the late rains there was insufficient material for the planned variety trial and multiplication plots were planted instead.

Some of last year's crop was left in the soil well into the dry season to see how long it could stand the drought. Although the plants remained alive despite the lack of moisture, by New Year the roots were so badly attacked by *Cylas puncticollis* that they were unfit for human consumption. The yield of this crop, which was not harvested until well into the dry season, was only slightly lower than the crop harvested at the regular time.

Sweet potato seed from open-pollinated flowers has been collected for starting new clones.

EUROPEAN VEGETABLES

Certain European vegetables, particularly carrots, potatoes, and tomatoes are becoming increasingly important in the agriculture of the Nigerian farmer. Others such as beans, cabbage, cauliflower and lettuce are of less importance. Trials continue, comparing proved varieties with new introductions, to select the best for local conditions.

Vegetable Fertiliser Trials.—Investigations into the local fertiliser requirements of these crops under our conditions were carried out. A leaf crop (cabbage), a root crop (carrots) and a fruit crop (tomatoes) were chosen as representative vegetables and each vegetable was given four treatments.

(i) Nil.

(ii) Sulphate of ammonia at 3 cwt per acre.

(iii) Superphosphate at 5 cwt per acre.

(iv) Sulphate of ammonia at 3 cwt per acre plus Superphosphate at 5 cwt per acre.

The fertilisers were scattered broadcast on the bed at planting or transplanting time and raked into the surface. The cabbage and tomato plants were raised in soil blocks and transplanted into the beds successfully.

TABLE 126.—CABBAGE N AND P FERTILISER TRIAL
Yields of Heads in lb. per acre

<i>Treatment</i>	***
Nil	2,414
Sulphate of Ammonia 3 cwt per acre	5,578
Superphosphate 5 cwt per acre	2,396
S. of A 3 cwt/acre + Super 5 cwt/acre	18,773
S.E.	±871

Superphosphate appeared to cause a delay in head formation and this may be the reason for the slight decrease in yield over control. Although sulphate of ammonia gave a significant increase when used alone it is obvious that the combination of this fertiliser with superphosphate is needed for good yields.

TABLE 127.—TOMATO N AND P FERTILISER TRIAL
Yields of Fruit in lb. per acre

<i>Treatment</i>	*
Nil	1,217
Sulphate of ammonia 3 cwt per acre	1,306
Superphosphate 5 cwt per acre	1,426
S. of A. 3 cwt per acre + Super 5 cwt/acre	1,815
S.E.	±128

At first the different treatments caused a great difference in vegetative growth of the plants. This difference was greatly reduced about the time the plants started producing fruit by heavy attacks of *Septoria* leaf spot and other fungus leaf diseases. These diseases plus blossom end rot reduced the yields to a very low level. The only treatment which gave a significant increase in yield was sulphate of ammonia plus superphosphate which was better than all the others at the 5 per cent level.

The plots of this trial were also split and a complete solution of minor elements (minus lime) was applied to half of each plot. Although it was impossible to see any consistent differences in vegetative growth between the two treatments, the plants receiving minor elements gave an increase in yield, significant at the 5 per level, over the untreated plants. (See Table 129).

TABLE 128.—THE EFFECT OF MINOR ELEMENTS ON TOMATOES
Yields of Fruit in lb. per acre

<i>Treatment</i>	<i>*</i>
Nil	1,344
Plus Minor Elements	1,537
S.E.	±57
5 per cent sig. diff.	167

TABLE 129.—CARROT N AND P FERTILISER TRIAL
Yields of Roots in lb. per acre

<i>Treatment</i>	<i>A (wet season)</i>	<i>B (dry season)</i>
	N.S.	**
Nil	4,329	2,626
Sulphate of Ammonia 3 cwt/acre	4,390	3,920
Superphosphate 5 cwt/acre	5,227	4,441
S. of A. 3 cwt/acre + Super 5 cwt/acre	6,311	9,795
S.E.	±818	±653

The wet season planting of this trial was very poorly sited. This factor, plus the early ending of the rains, may in part account for the fact that there were no significant differences between the treatments of the first planting. However, the trend in the yields of the different treatments was similar to the trend in yield of the dry season planting. In the dry season planting the sulphate of ammonia gave an insignificant increase in yield over the nil; the superphosphate gave an increase in yield over nil which approached significance at the 5 per cent level; while the treatment with both sulphate of ammonia and superphosphate outyielded all other treatments at the 1 per cent level.

These preliminary trials indicate that a combined application of nitrogen and phosphate is necessary for these crops. The optimum rates of application are still to be determined.

NATIVE VEGETABLES

Replies to a questionnaire showed that over sixty-five different plants, both wild and cultivated, are used as vegetables in the native diet of the Region. In some cases it was necessary to send specimens to Kew for identification.

Last year the following twenty-two types of native vegetables were collected and grown at Samaru for observation and selection:

Amaranthus caudatus, *A. viridis*, *Canavalia ensiformis*, *Capsicum frutescens*, *Celosia argentea*, *Ceratotheca sesamoides*, *Citrullus vulgaris*, *Coleus dazo*, *C. dysentericus*, *Corchorus olitorius*, *Cucurbita* spp., *Cyperus esculentus*, *Dioscorea* spp., *Hibiscus cannabinus*, *H. esculentus*, *H. sabdariffa*, *Lagenaria siceraria*, *Phaseolus lunatus*, *Solanum incanum*, *Sphenostylis stenocarpa*, *Trichosanthes anguina*, *Voandzeia subterranea*.

Investigations are being carried out on the relative values and potentialities of certain of these. This involves answers to such questions as optimum methods of cultivation, breeding habits, yield, relative importance in the native diet and the qualities in the vegetable desired by the consumer. Very many of these are at present unknown quantities.

FRUIT TREES

Citrus Stock Trials.—Material for the proposed Citrus Stock Trials has not yet reached the point where the experiments can be planted. Seedlings have been subjected to an unfortunate series of attacks by diseases and pests. New lots have had to be started and it is hoped that by the end of 1957 we will have ample material for budding in 1958.

Distribution of Fruit Trees.—During the year under review a total of 728 plants were distributed to substations, members of the Department and private individuals. The small orchard at Maska has kindled the interest of the local people and distribution of a number of trees to them took place.

Actual numbers of plants distributed from the nursery are shown below:

							<i>Samaru</i>	<i>Outside</i>	<i>Foreign</i>	<i>Total</i>
Orange ...	...	...	...	...	...	...	53	92	29	174
Tangerine ...	...	...	...	...	...	...	19	4	4	27
Grapefruit ...	...	...	...	...	...	...	25	19	14	58
Tangelo ...	...	...	...	...	...	...	2	8	1	11
Lemon ...	...	...	...	...	...	...	8	4	4	16
Lime ...	...	...	...	...	...	...	8	4	—	12
Guava ...	...	...	...	...	...	...	12	43	—	55
Avocado ...	...	...	...	...	...	...	6	4	—	10
Sour Sop ...	...	...	...	...	...	...	3	5	6	14
Mango ...	...	...	...	...	...	...	37	61	15	113
Banana ...	...	...	...	...	...	...	11	26	—	37
Pomegranate ...	...	...	...	...	...	...	—	11	—	11
Cashew ...	...	...	...	...	...	...	—	14	—	14
Pawpaw ...	...	...	...	...	...	...	50	126	—	176
							234	421	73	728

Numerous consignments of seeds of pawpaw, cashew, guava and rough mon seed were also made.

Citrus Fertiliser Trial.—A trial was started in 1954 using four fertilizer treatments on citrus trees. These are—

						oz. per tree
1	Ammonium sulphate as a spray	...	...	...	...	25.4
2	Ammonium sulphate in the soil	...	...	...	...	76.2
3	Urea as a spray	...	...	...	...	11.6
4	Urea in the soil	...	...	...	...	34.8

six trees per treatment were used and six trees were given no treatment as a control. Applications are made three times a year i.e. July, December and May. Results to date are shown in Table 123.

TABLE 130.—CITRUS FERTILISER TRIAL, SAMARU

Treatment				1954	1955		1956		Total No. of Fruits
				No. of Fruits	No. of Fruits	Wt. of Fruits	No. of Fruits	Wt. of Fruits	
						Lb.		Lb.	
Urea in Soil	...	...	...	385	56	26	754	305	1,195
Urea as Spray	...	...	...	428	168	79	94	52	690
Urea in Soil	...	...	...	187	198	77	299	135	684
Urea as Spray	...	...	...	387	339	138	678	241	1,404
Control	...	...	...	509	120	54	848	308	1,477

Results to date are not encouraging and no definite trends are yet being established. One of the difficulties encountered is that the trees used in the trial were mature when the experiment was begun. The trees were a representative sample of those existing in the orchard and some are in rather poor shape as no irrigation is permissible during the dry season.

PLANT INTRODUCTIONS

Samples of seed were obtained from many parts of the world. Many of these were sent in return for seeds despatched by us to countries overseas. The remainder of the Sudan collection was received, the bulk having been obtained during the previous year. The following list shows the number of introductions and their origin.

<i>Crop</i>		<i>No. of Varieties</i>	<i>Origin</i>
Potato ...	...	10	United Kingdom
Groundnut ...	...	413	Senegal, U.S.A., Philippine Islands, South Africa, Sudan, India, Russia and Australia
Cowpea ...	...	68	U.S.A., South Africa, Ghana, Hungary, India
Benniseed ...	...	71	Venezuela, Sudan, U.S.A., Canada
Soya Bean ...	...	15	Sudan, U.S.A., Hungary
Rice ...	...	9	Sierra Leone, Senegal
Safflower ...	...	6	Sudan
Sunflower ...	...	6	Sudan
Persimon ...	...	2	U.S.A.
Lima Bean ...	...	6	} Hungary
Chick Pea ...	...	7	
Greengram ...	...	12	
Vetch ...	...	4	
Proso Millet ...	...	7	
Kidney Bean ...	...	5	
Castor ...	...	9	
Broad Bean ...	...	16	} Hungary, East Africa
Pigeon Pea ...	...	3	
		Total	<u>669</u>

C. PLANT PATHOLOGY

GROUNDNUTS

(*Arachis Hypogaea*) (R.EW.)

A spraying trial with two fungicides was carried out on three varieties of groundnuts to investigate the effect on the *Cercospora* leaf spot.

The varieties used were Samaru 38 and Mwitunde, both long season types, and Spanish 205, a short season type susceptible to the leaf spot. The fungicides used were proprietary formulations of cuprous oxide and dispersible sulphur.

It was found that in Samaru 38 and Spanish 205 the treated plants significantly outyielded the control plants. This was not the case with Mwitunde, although one treatment outyielded the control.

In all varieties treated plants had significantly less spotting though, in the case of Mwitunde, there was no effect on the yield. Varietal reaction to the disease seem to differ, the disease certainly causing more defoliation on Spanish 205. The results are summarised in Table 131.

TABLE 131.—SPRAYING TRIAL ON GROUNDNUTS

+ cu *Sprayed with Cuprous Oxide.*
+ s *Sprayed with Dispersible Sulphur.*

Treatments					kernels lb/acre	haulms lb/acre	<i>Cercospora spots</i> (Comparative Samples)
					***	***	***
Samaru 38 + cu	...	...	...	...	562 (1)	1,010 (2)	146 (2)
Samaru 38 + s	...	...	...	...	530 (2)	1,142 (1)	183 (3)
Danish 205 + cu	...	...	...	...	431 (3)	321 (7)	393 (7)
Samaru 38 Control	...	...	...	...	396 (4)	850 (6)	326 (5)
Twitunde + cu	...	...	...	...	378 (5)	963 (4)	134 (1)
Danish 205 + s	...	...	...	...	366 (6)	320 (8)	506 (8)
Twitunde Control	...	...	...	...	351 (7)	970 (3)	387 (6)
Twitunde + s ...	...	...	...	...	289 (8)	942 (5)	219 (4)
Danish 205 Control	...	...	...	...	280 (9)	255 (9)	911 (9)
S.E. ...	...	...	...	...	±39	±59	±48

Fungicide seed Dressing Trial.—A trial using four different fungicidal seed dressings was instituted. Even though the trial was planted during a dry period when some loss is to be expected, there was no significant difference in germination between treatments; in fact the control had a higher germination count than the treated plants. Yield analyses also showed no significant differences.

Blind Nut Trial—Dambatta.—A variety trial of twenty-eight varieties was laid down at Dambatta on the field that had given the highest number of Blind Nuts in the previous year. The object was to determine the degree of varietal susceptibility to this malady. As it had been found in previous work that there is a highly significant negative correlation between shelling percentage and Blind Nuts, the former was taken as an expression of the latter. It was found that the earlier maturing varieties are much less susceptible and that the standard varieties—Kano 50, Samaru 38 and Castle Cary—are extremely susceptible. Throughout, however, the shelling percentages were very low. Further work on blind nuts is reported under the Chemistry Section.

Rosette Disease.—Rosette was widespread and in many places severe. This was especially true of the Middle Belt where the late planting caused by the widespread drought inevitably led to a heavy attack.

At Kontagora an observational trial was laid down to investigate the effect of ridging direction in relation to the prevailing wind. There were four rectangular plots:

Plot 1	...	...	Ridged	N.S.	long axis	N.S.
Plot 2	...	...	Ridged	E.W.	long axis	N.S.
Plot 3	...	...	Ridged	N.S.	long axis	E.W.
Plot 4	...	...	Ridged	E.W.	long axis	E.W.

Each plot was divided into two, half being early planted and the other half planted a fortnight later.

The prevailing wind during the rains is West to South West. A weekly count of rosette incidence was made and also a complete plotting of spread made once. It was hoped that the latter would have been done weekly but staff shortage precluded this. The results of the plot are shown in the table below.

TABLE 132.—OBSERVATIONAL TRIAL ON ROSETTE, KONTAGORA

Plot	Total number of infected plants	Number of adjacent infected plants (doublets)			S.E.
		Expected	Along the ridge	Across the ridge	
1 Early	161	11	25 **	15 N.S.	±3.3
1 Late	403	69	89 N.S.	71 N.S.	±8.3
2 Early	214	20	17 N.S.	19 N.S.	±4.5
2 Late	487	102	107 N.S.	97 N.S.	±10.1
3 Early	82	3	4 N.S.	5 N.S.	±1.7
3 Late	315	43	66 *	46 N.S.	±6.6
4 Early	194	15	20 N.S.	9 N.S.	±3.9
4 Late	363	53	83 **	58 N.S.	±7.3

These results show that there appears to be no spread from ridge to ridge although there may be spread along the ridge, plant to plant. The direction of ridging and orientation of the field appears to have no effect.

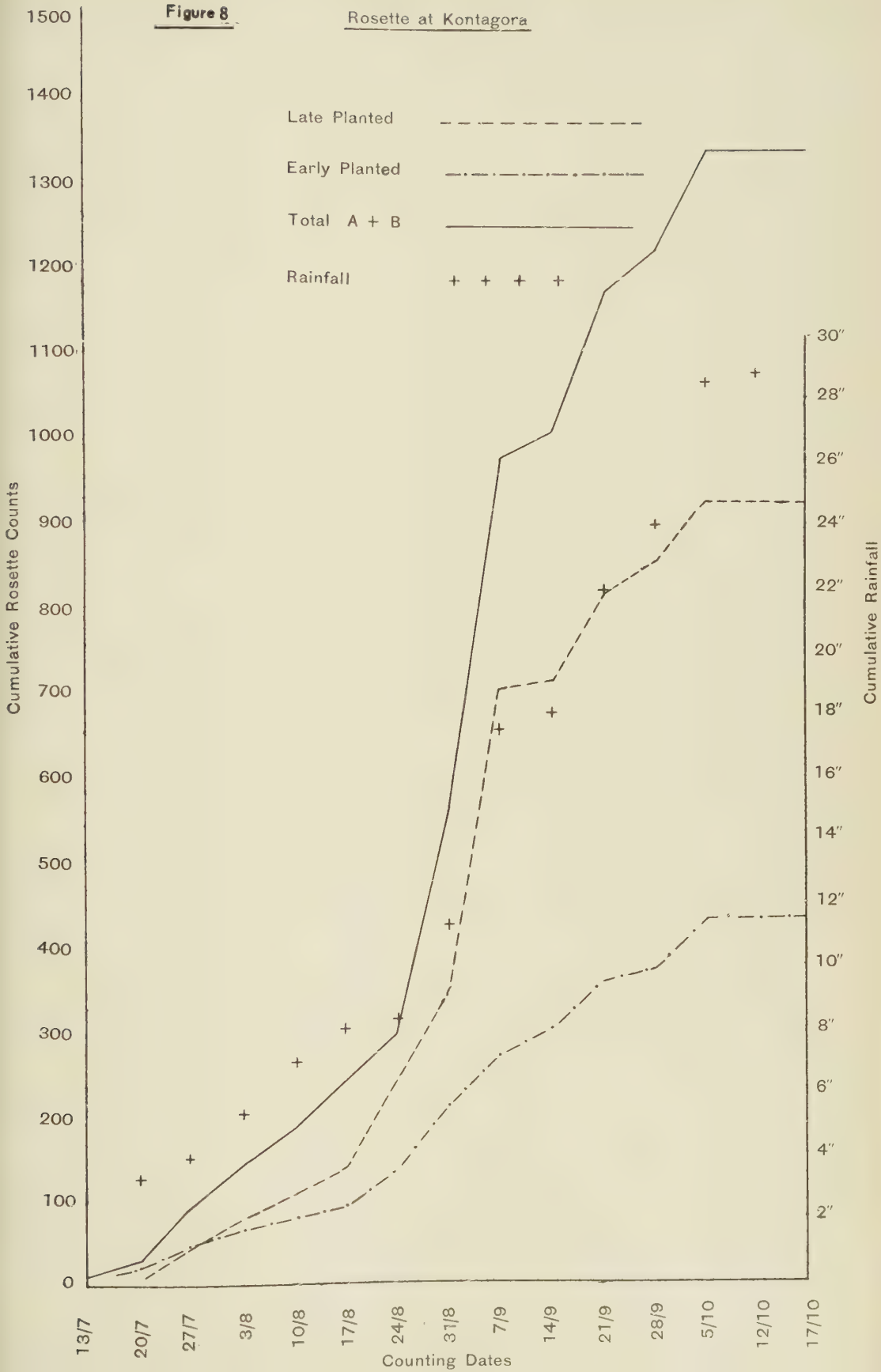
Late planted groundnuts have a higher degree of infection and there appears to be a tendency to greater spread on the ridge. (Plots 3 and 4 significantly so, $P = .05$ and $.01$ respectively, and Plot 1 approached significance).

Graph No. 8, Rosette at Kontagora, shows the build up of rosette. This is compiled from the mean data of the four plots: the rainfall figure are superimposed for comparison. The most striking feature is the sudden rise in numbers after mid-August especially in the later planted groundnuts. This may be explained that the straight line from the beginning until mid-August shows the increase in primary infections and that the large leap reflects the resultant secondary spread within the plots.

The rainfall figures show the same pattern but it cannot be adduced that the spread of infection follows the rainfall because the apparent increase in the latter half of August is in reality an increase in the first half because there is an incubation period of about fifteen or more days before symptoms appear.

Figure 8

Rosette at Kontagora



GUINEACORN
(*Sorghum vulgare*).

Inoculation trials were carried out with several varieties to determine resistance to *Sphacelotheca sorghi*, covered smut, and *Sclerospora sorghi*, downy mildew, two important diseases of guineacorn. The smut inoculations carried out by dusting the seed with smut spores before sowing, were successful. However no infection with downy mildew was obtained by laying leaf tissue containing oospores over the seed before covering it with soil; it is hoped to try seedling inoculation in the future.

A heavy infection of *Sclerospora sorghi* occurred on Short Kaura guineacorn at Shika, some of the severest infection (40-50 per cent) being on plots of newly opened land. Downy mildew usually causes sterility in guineacorn but many of the affected plants headed although the heads were poor, later than those on healthy plants and incompletely emerged from the flag leaf. It was not possible to trace the origin of this outbreak. Seeds from affected plants have been grown in the greenhouse at Samaru and the seedlings produced are healthy.

The following were also recorded:

1. Heads of guineacorn apparently infected by *Ephelis* sp., were received from Sokoto Province
2. *Leptosphaeria* sp., causing a large white leaf spot on guineacorn at Samaru and in other areas.

MILLET
(*Pennisetum typhoides*)

Although sclerotia of *Sphacelia* sp., honeydew disease, were floated off from all the millet seed planted on the Botanist's Farm infection was still widespread in the crop. In the absence of information about the life history of this disease early planting is the only control method that can be recommended.

Fusarium moniliforme was consistently isolated from millet affected by a stalk rot on the Agronomist's Farm. The rot was accompanied by a bright yellow discolouration of the leaves.

RICE
(*Oryza sativa*)

Rice diseases were studied at Lowland Experimental Farm. Leafspots were very numerous and *Cercospora* sp., and *Trichoconis* sp., were present on these and on discoloured glumes in addition to the very common *Helminthosporium oryzae*. A small sample of seed from the crop has been treated by immersion in hot water (54°C for five minutes) and will be grown in an observation plot on the farm next season.

BENNISEED

(Sesamum indicum)

Benniseed diseases were investigated in July at Yandev. Fields planted only a week or two after the rest of the early crop gave very poor yields. In addition to the attack of a gall midge on the pods, yield was found to be limited by a powdery mildew, *Oidium* sp., which caused death of the growing point before more than a few pods had been formed on the later planted varieties. *Cicinnobolus cesatii* occurred as a hyperparasite on the *Oidium* sp. Powdery mildew was also troublesome at Samaru on plants grown in the greenhouse for breeding work; a sulphur spray was used about once every two weeks to control the mildew. Leaf spots caused by *Cercospora sesami* and *Cylindrosporium sesami* were also common at Yandev and *Corynespora cassiicola* was found on stem lesions. A *Fusarium* sp., caused wilt of plants grown at Samaru from seed obtained in Kabba Province.

TOMATOES

(Lycopersicon esculentum)

Septoria lycopersici, leaf spot, was recorded in several localities. At Samaru leaf spots caused by *Alternaria solani* and *Stemphyllium solani* (a new record for West Africa) were also recorded. Blossom-end rot continued to cause considerable damage at Samaru and a *Phytophthora* sp., causing fruit rot was common in the rainy season. There was also a fair amount of leaf curl (? virus) on tomatoes at Samaru.

MISCELLANEOUS CROPS

A *Diplodia* sp., not yet identified but possibly *D. phoenicum*, occurred on leaf bases of the date palms attacked by a bud and leaf base rot at Fika in Bornu Province.

Cercospora canescens and *Pseudoplea* sp., were found on large triangular leaf spots on groundnuts at Samaru.

Cercospora citrullina was recorded on water melon at Samaru.

Leaf spots caused by *Alternaria macrospora* were common on the first leaves of cotton seedlings at Samaru.

Myrothecium roridum caused leaf sports on okra at Samaru.

A very heavy infection of *Alternaria solani*, early blight, was seen on almost mature potatoes at Riyom in July.

IV—Cotton

INTRODUCTION

Despite the poor growing season yields on the farm at Samaru, with timely (early July) planting, did not seem to be greatly affected; the final figures were on the whole equal to, or somewhat above, those of last season.

Some fields, early planted and well treated, gave very high yields indeed for Nigeria; over 1,100 lb., of seed cotton per acre were recorded in one instance.

At Daudawa also, some exceptionally high yields were recorded; a 16 acre field of "second wave" 26J averaged over 700 lb., of seed cotton per acre. It appears that with a higher yielding strain, timely planting and the use of fertilisers, the adverse effect of poor weather may be very substantially reduced. A common feature of the season, however, shared by both good and bad crops, was the late arrival of the crop; boll setting was very poor early in the cropping season and fruiting was in consequence very long drawn out compared with a normal season.

Mr B. J. S. Lee arrived on transfer from Uganda to join the plant breeding staff and assist with climatological and crop physiology work. Further deterioration of the African staff position caused great delay particularly in the laboratory work. Mr M. G. Emsley, Entomologist, resigned to take up a post in Trinidad.

COTTON BREEDING

by

H. E. King and D. A. Lawes

Hybridization, Progeny Rows and Small Bulks

The breeding work was continued on established lines with some hybridization using imported types, but the main effort still concentrated on straight reselection within the local "Allen" stocks.

The results of a series of replicated progeny row tests and some small bulk trials were somewhat disappointing and difficult to interpret, presumably as a result of the late season which (for the second year running) appeared to cause some reversals of behaviour of previously most promising selections.

In view of this, detailed results will not be discussed here but it can be recorded that a few types of undoubted and sustained promise, particularly as regards high seed cotton yield and high ginning percentage, emerged for larger scale tests.

It seems likely that difficulty will be experienced in advancing the lint yield much further within the Allen material without some fall in lint length and spinning quality: there is a definite tendency for high yield to be associated with below average lint length. The failure of the line 26C/49160-23, mentioned in a number of previous reports as combining high yield and very good quality, has left a gap.

Strains Test

The usual replicated field test at Samaru, containing a range of imported strains of various origins together with all the more promising local selections, was carried through.

Yields were good and strain differences large, but the accuracy of the comparisons, in spite of the ten replications employed, was not high.

As recorded in previous seasons, no imported type showed any real promise of competing with 26C and 26J in merit for commercial growth here. Those giving higher seed cotton yields fell away when their lower ginning percentage was taken into account.

Even types such as Punjab 268F imported solely on their reputation for yield, irrespective of spinning quality, do not stand out as really high yielders (in terms of ginned lint) at Samaru. Albar types and reselections and a number of local reselections from Uganda BP 52 were likewise disappointing in yield.

District Variety Tests

The usual series of replicated tests, sited at experiment stations throughout the cotton growing areas, was carried out. Results were more than usually erratic both in level of yield and accuracy of varietal comparisons. Conditions for establishment of a good stand of seedlings were particularly difficult at certain stations, with the result that overall stands were poor and, in addition, significant differences between strains in percentage stand appeared. At other sites, where conditions were easier, each of the eight strains showed equally good germination (as they had done also in laboratory germination tests). It would seem that, although equally viable under good conditions, there were differences in vitality of the seed.

Results from two of the sites were rendered useless on this account, while a third site, Maiduguri, had to be ruled out through severe locust damage. Yield data from the remainder still showed such wide variations in accuracy that no overall comparisons of strains could usefully be made. Figures from the more accurate tests considered alone confirmed the superiority of 26J over 26C shown in previous seasons (and also in the Seed Stocks Trial at Samaru this season—see Table 133). Of the new selections included, none was outstanding everywhere, but one, a 26C/499 derivative, did extremely well in seed cotton yield in two Samaru tests,

Seed Stocks Trial

To obtain confirmation of the relative yield, ginning percentage and lint length of 26C and 26J, an additional trial was laid down this season, at Samaru only, in which two seed stocks of each strain were included using a plot size of 1/20 acre and eight replications arranged in two 4 x 4 Latin squares.

Growth was no more than reasonably good, and the yield representative of what a good cultivator might reasonably be expected to attain. The yields and lint lengths are given in Table 133 below. Notes made during the season on a plot by plot basis brought out clearly that the "Multiplication Stock" of 26C was superior to the Commercial Stock in uniformity and in

resistance to jassid, and that both stocks of 26J were superior to 26C in appearance and quite satisfactorily resistant to jassid under the conditions of this experiment.

A further point concerning the difference between the two strains, not brought out by the figures for total yield in Table 133, was the greater earliness of the two 26J seed stocks. These had given 32 per cent of their crop before the end of December while the two 26C stocks had given only 28½ per cent.

TABLE 133.—RESULTS OF SEED STOCKS TRIAL, SAMARU

<i>Seed Stock</i>	<i>Seed cotton lb. per acre</i>	<i>Gin per cent</i>	<i>Lint lb. per acre</i>	<i>Lint as per cent of Comm.</i>	<i>Seed weight (2)</i>	<i>Lint index (3)</i>	<i>Lint length mm (4)</i>
(1)							
Commercial stock of Samaru 26C ...	670	35.7	238	100	9.5	53	33.1
Multiplication stock of Samaru 26C	680	37.0	250	105	9.6	56	33.9
First Wave 26J	735	36.1	265	111	9.3	52	34.5
Second Wave 26J	734	36.3	265	111	9.3	53	34.8
S.E.	—	—	±11.8	±4.9	—	—	—

(1) Commercial seed from a number of ginneries mixed.

(2) Weight of 100 seeds in grams.

(3) Weight of lint per seed in mgms.

(4) Bailey halo.

Seed Multiplication

The multiplication plots at Samaru yielded satisfactorily. Many of the larger ones were used for agronomic experiments, treatments such as manuring, cross-tying of ridges and mulching being superimposed. The layout was arranged to confound strain differences with blocks of the replicated experiment. This enabled trials to be carried out for which otherwise no land was available, and did not seriously interfere with seed production.

The early stages of seed multiplication on the Daudawa Farm were very successful, yields being notably high considering the poor season in Katsina Province in general. This applies also to the first stage beyond the government farm—the stage D area of approximately 4,000 acres farmed by peasant settlers around Daudawa. This, growing the first wave of Samaru 26J, produced ample seed for the following 27,000 acre stage in Southern Katsina, plus 30 tons for issue to the Gombe seed multiplication scheme and some surplus for trials elsewhere. The good crop may be attributed in part at least to the high yielding powers of 26J.

The seed multiplication scheme in Gombe Division of Bauchi Province also produced an extremely good crop once more and provided adequate good seed of 26C for issue throughout the Gombe ginnery area and beyond.

AGRONOMY AND CROP PHYSIOLOGY

by

H. E. King and D. A. Lawes

Certain long term agronomic experiments designed to elucidate the interaction of planting date with soil fertility and with time of application of nitrogenous and phosphatic fertilisers was continued in co-operation with the agronomist.

The results in general followed those given in last season's report pages 74-76 and will not be presented here in detail.

Consideration of past results of agronomic and other experiments has led to the belief that factors other than soil nutrients have an overriding effect on yield levels. In particular the complete failure of fertilisers to counteract the depressing effect of delay in planting is thought to be due to the limiting effect of soil texture and surface impermeability.

A number of new experiments and field observations planned to test this belief were therefore commenced. These included a series of gauges from which rainfall run-off could be measured using a range of soil surface treatments and mulches. Some preliminary results of great interest were obtained and have been made the subject of a separate report already published* Amongst the field experiments the response of both cotton and sunflower to a heavy surface mulch of groundnut shell was remarkable. Since the amount of shell produced per acre of the groundnut crop is inadequate for the really large scale use of this material the results obtained must be regarded solely as a pointer to the need for further study of means of protecting the soil surfaces.

Cross-tying of furrows, in this season of below average rainfall, gave a 14 per cent increase in yield of seed cotton. The ridges were at 3 feet spacing and the cross ties at 4 yard intervals.

An experiment designed to show whether an unusually heavy dressing of farmyard manure (12 tons per acre against a "normal" dressing for Northern Nigeria of 1 or 2 tons) would conspicuously improve soil texture was inconclusive. The growth of cotton following the ploughing in of this quantity of manure was strong to the verge of rankness but was just about equalled by that produced by fertilising with sulphate of ammonia and superphosphate in quantities containing comparable amounts of N and P.

* Lawes, D. A. Preliminary report on soil-water-crop relationship at Samaru, 1956. Emp. Cott. Gr. Rev. XXXIV, 3, July, 1957.

In neither case was there any serious waterlogging and there were no conspicuous differences in apparent soil texture and permeability to be reflected in growth or yield of the cotton. The yields were in fact almost equal at a level of approximately 1,200 lb seed cotton per acre.

The unusually low rainfall and low level of pest incidence both render this result of doubtful utility. Such heavy manuring can, in some circumstances, result in a grossly rank, unfruitful, diseased and insect-ridden crop.

COTTON ENTOMOLOGY

by

M. A. Choyce and M. G. Emsley

Routine records of insect pest incidence throughout both the main (northern) cotton growing areas and the Riverain or Middle Belt region were continued. In the Riverain provinces cotton stainers as well as bollworms were an important factor in reducing yields, and at Mokwa it was found that three generations occurred within the crop during the season.

Trials of insecticides were continued at Samaru and started at Mokwa, where the importance of insect control measures would appear to be very much greater than in the more northern areas.

At Samaru, applications of insecticide to cotton again resulted in uneconomic yield increases, but at Mokwa control of the primary invasion of stainers was followed by yield increases from June sowings of over 1,000 lb. seed cotton per acre. Further investigations into the economic use of insecticides at this station are proceeding.

A technique for sweeping and counting the number of mirids in a cotton field was developed, and it was shown that *Campylomma* populations of the order of 150,000 per acre were present during early October.

Bollworms.—Bollworms of all species were less common in the crop than last year. The figures in Table 134 are comparative and show the numbers of bollworms collected in fortnightly samples on ten ridges of 10 yards throughout the season.

An examination of seed cotton samples from various markets also showed a reduction in the numbers of pink bollworms (Table 135).

TABLE 134.—SEASONAL TOTALS OF BOLLWORMS FROM CROP SAMPLES AT VARIOUS STATIONS

Station	Red bollworm	Spiny bollworm	Pink bollworm	American bollworm	False codling moth	Not identified
Samaru	82	6	18	0	0	0
Gombe	129	21	6	1	0	0
Kontagora	230	95	17	10	0	0
Mokwa	93	86	22	12	14	0
Shendam	29	57	53	2	3	2
Total	563	265	116	25	17	2

TABLE 135.—PINK BOLLWORMS FOUND IN SEED COTTON SAMPLES FROM COTTON MARKETS

N.A. grade	No. of samples	Larvae inside seed		Larvae outside seed		Totals		
		Living	Dead	Living	Dead	Living	Dead	L and D
I	29	33	34	1	2	34	36	70
II	35	19	16	5	2	24	18	42
III	24	11	6	1	2	12	8	20
Total	88	63	56	7	6	70	62	132
Number of larvae per 10 lb. sample 1956-57						8.6	7.7	16.3
Number of larvae per 10 lb. sample 1955-56						7.1	18.4	25.4

Mirids.—Using a sampling technique described elsewhere*, the population of mirids on the investigation plot of cotton at Samaru was determined with reasonable accuracy.

The abundance and names of genera collected are shown in Table 136 which also includes data from Mokwa and Shendam. At Samaru, *Campylomma* A is the most common species, whereas at Shendam and Mokwa species B is more abundant.

*Emsley, M. G. A coarse method of determining mirid populations in the field. Emp. Cott. Gr. Rev. XXXIV, 3, July, 1957.

Specimens of *Campylomma* A caught during September and October contained gravid ovaries, and oviposition occurred during early and mid-October. The population of nymphs reached its peak during late October and a further generation of adults was produced in November. From the population curve it seems that the life cycle of this species from adult to adult takes about five weeks. Species B apparently does not breed on cotton.

Campylomma spp., *Lygus*, *Eurystylus*, *Stenotus* and other genera all occur on cereal crops during heading. *Campylomma* also breeds very commonly on *Veronica pauciflora* Less and *Ethulia conyzoides* Linn., both very common plants which frequently grow between cotton ridges when weeding has been neglected.

Preliminary observations on the feeding habits of insects in captivity show that all three species of *Campylomma* feed upon the growing point and on the undersides of young leaves. During feeding the leaf hairs are grasped by the tarsi, and the stylets, after an examination of the surface with the tip of the rostrum, are embedded in the tissue. The stylets are retained in position for about five seconds then withdrawn and re-inserted a little further away. There is no visible motion of the stylets whilst embedded. The feeding of *Stenotus* and *Eurystylus* on leaf tissue is similar except that the stylets may remain embedded for two or three minutes. *Lygus* moves its stylets up and down within the tissue of the growing point or leaf.

Crop Records.—Flower-tagging records were continued at Samaru, Gombe, Kontagora, Shendam and Mokwa throughout the season. These records are being accumulated for analysis over a period of years.

Table 136.—MIRIDS, IN 1,000'S PER ACRE, SWEEPED OFF SAMARU MIRID INVESTIGATION PLOT DURING 1956-57, AND FROM COTTON AT MOKWA AND SHENDAM

Date swept Genus	Samaru										Mokwa		Shendam
	6/9	24/9	4/10	11/10	25/10	8/11	12/11	23/11	7/12	6/1	31/10	4/12	18/10
<i>Campylomma</i> sp. A	< 10	122	149	60	9.5	53	58	5	3.5	0.2	1.0	0.4	2.4
<i>Campylomma</i> sp. B	< 4	52	20	4.5	1	0	0	0	0	0	9.6	0.8	16
<i>Campylomma</i> sp. C	—	0.2	0.3	0	0.1	0	0	0.1	0	0	0	0	0.2
<i>Lygus</i> spp.	—	3.2	1.0	2.9	1.0	0.1	0.1	0.1	0	0	1.0	0	0.9
<i>Lygus</i> <i>vosseleri</i>	—	0.5	0.4	0.1	0	0	0	0	0	0	0	0	0.2
<i>Eurystylus</i> sp.	—	0.2	0	0	0	0	0	0	0	0	0.2	0	0
<i>Stenotus</i> sp.	—	0.3	0.1	0.3	0.1	0	0.2	0	0	0	0.2	0	0
<i>Psallus</i> sp.	—	1.0	1.0	0.1	0.1	0	0	0	0	0	0	0	0
<i>Campitobrochis</i> sp.	—	2.8	3.4	3.0	0.1	1.1	2.7	0.1	2.0	0	0.2	0	1.9
<i>Creontiades</i> sp. ...	—	0	0	0.1	0	0	0	0	0	0	0	0	0.1
Others ...	—	1.2	0.1	1.2	0.5	0	0.1	0.3	0	0	0.8	0	1.7

(< = less than. > = more than).

Insecticide Trials

Samaru.—In a date-of-sowing trial there were four replications of twenty plots, each 3 x 12 yards, sown serially with cotton at intervals of four days over a period extending from mid June to the end of August. On two replications, sowings up to mid July were sprayed at weekly intervals from 21st August to 20th November, the later sown plots being included in the spraying programme as the plants became about twelve inches high. The spray consisted of a mixture of DDT and gamma BHC applied at the rate of 2 lb. and 0.6 lb. per acre respectively.

Germination of some of the earliest sown plots was irregular owing to lack of rain, and growth over the whole experiment was poor. Analysis of the final yields (Table 137) showed that sowing date had an extremely marked effect on yield, whether insecticide was applied or not.

Yield increases of a similar order were obtained in a trial comparing the effect of endrin with that of DDT/BHC (Table 138). Five applications of insecticide were made at weekly intervals from 6th October to 2nd November, on cotton sown on 12th July.

The occurrence of plants with distorted roots was noted in the Annual Report for 1955-56. This year it was found that the addition of 0.5 gm. of "Agroside" 3 (containing 0.65 per cent gamma BHC) to the planting holes of raw 26C had no effect on the percentage of damaged roots. In this experiment the cotton was planted on 9th July, and about four-fifths of the plants in treated and untreated plots had normal roots when uprooted in November. The insecticide had no effect on germination, plant height or on the incidence of bacterial blight.

TABLE 137.—SERIAL SOWING DATE OF COTTON, WITH AND WITHOUT APPLICATION OF INSECTICIDE, SAMARU, 1956-57

<i>Sowing Date</i>	<i>Yields of Seed Cotton in lb. per acre</i>		
	<i>Unsprayed</i>	<i>Sprayed</i>	<i>Difference</i>
15th June to 30th June	277	391	114
1st July to 15th July	252	438	186
16th July to 31st July	248	319	71
1st August to 15th August	87	182	95
16th August to 31st August	13	31	18

TABLE 138.—INSECTICIDE TRIAL ON COTTON, SAMARU, 1956-57

<i>Treatment</i>							<i>Yield of Seed Cotton in lb. per acre</i>
DDT, 2 lb./acre plus g.BHC, 0.6 lb./acre	...	...	...	...	...	...	552
Endrin, 0.4 lb./acre	...	...	...	...	...	...	520
Control	...	...	...	...	...	...	403
S.E.							±36

Kontagora.—Following on the experiments carried out at this station during the past two years, it was shown that a series of four sprays applied during September and early October gave higher yields than a similar series of sprays applied during October and early November (Table 139).

TABLE 139.—INSECTICIDE TRIALS, KONTAGORA, 1956-57

- (a) Layout: six replications of two plots, each 1/18 acre, plots split for two sowing dates.
- (b) Sowing dates: 15th June and 3rd July
- (c) Treatments: 1. 2 lb DDT plus 0.6 lb gamma BHC per acre, as emulsion, applied at 54 gallons per acre.

2. Control.

- (d) Dates of application:

Trial A: 3rd, 17th September, 1st and 15th October.

Trial B: 1st, 15th, 29th October and 12th November.

- (e) Results: Yields in lb seed cotton per acre.

							<i>Sowing date: 15th June</i>		<i>Sowing date: 3rd July</i>	
							<i>Sprayed</i>	<i>Control</i>	<i>Sprayed</i>	<i>Control</i>
Trial A	...	...	...	...	...	...	583	182	410	146
Trial B	...	...	...	...	...	...	204	111	167	79

Mokwa.—The relatively small increases in yield obtained at Samaru are in marked contrast to the results obtained at Mokwa, and reported elsewhere*. At Mokwa the cotton stainer is largely responsible for the low yields and poor quality of cotton obtained. During 1956 two generations of adults followed the initial invasion into the crop during September and early October.

*Choyce, M. A.—Insecticide trials in Northern Nigeria. Paper presented at the West African Cotton Research Conference, Samaru, Zaria, November, 1957. (In press).

In a date-of-sowing trial, which included cotton sown at 3-day intervals from June to September, the earliest sown plots were sprayed at 2-week intervals from 31st July to 20th November, with additional applications during October. Later sown plots were included in the spraying programme as they became about twelve inches high. The mixture consisted of DDT and gamma BHC applied at rates of 2.4 lb and 0.7 lb per acre respectively.

The height of the June sown cotton averaged about five feet, more than twice that of July sown cotton. Good control of stainers was achieved in the sprayed blocks and little breeding occurred. Examination during October of cotton sown during June showed that the sprayed plots carried 55 per cent more bolls than the unsprayed plots, and that the number of bolls with internal stainer damage was reduced from 65 per cent to 38 per cent. Summary of the yields obtained is given in Table 140.

TABLE 140.—DATE-OF-SOWING OBSERVATION TRIAL ON COTTON,
MOKWA, 1956-57

<i>Sowing date</i>						<i>Yields in lb. Seed Cotton/acre</i>		<i>Percentage increase</i>
						<i>Unsprayed plots</i>	<i>Sprayed plots</i>	
During June	...	...	...	...	...	455	1,483	226
During July	...	...	...	...	...	371	722	95
During August	...	...	...	...	...	209	241	15
During September	...	...	...	...	...	129	128	0

Trials with a tractor mounted spraying machine during September and early October in 5-acre fields showed that the tractor could cause considerable damage to early sown cotton. The results of spraying and dusting various fields of cotton are shown in Table 141.

As in the date-of-sowing trial, stainers entered the cotton during September and early October, and further generations of adults were produced in November-December and towards the end of January.

The comparatively low yields obtained from these large scale applications of insecticide are to some extent due to late sowing of the crop. The little cotton that was obtained from the untreated field during November and December contained a high proportion of stained lint.

In a trial to determine whether Rama (*Hibiscus cannabinus*) would act as a trap crop for stainers when interplanted with cotton, the Rama was sown in mid June and the cotton in mid July. Both crops were flowering in September and October, when the primary invasion of stainers occurred. Although the Rama attracted a higher population of stainers than the cotton it was clear that it did not prevent them from moving on to the cotton.

Shendam.—A dusting trial at Lowlands Experimental Farm, Shendam gave unsatisfactory results, and is to be repeated. Cotton stainers are numerous in this area and it is probable that control will give substantial increases in yield.

COTTON PATHOLOGY

By

H. M. Parker

Introduction.—The three main lines of investigation into bacterial blight (*Xanthomonas malvacarum*) this season were the relative importance of the methods of survival from one season to the next, varietal reactions to infection and the effect of seed treatment.

In general, plots and multiplication areas at Samaru and Daudawa were only lightly attacked where the seed had been treated with Agrosan GN 5. Plots sown with untreated seed showed moderate to severe seedling blight early on, followed by plentiful angular leaf spot and vein blight and towards the end of the rains more and more frequent blackarm (stem and branch lesions). After the rains boll and pedicel lesions were very few in number but large in size.

TABLE 141.—YIELDS OF SEED COTTON FROM VARIOUS FIELDS, MOKWA, 1956-57

- (a) Field J.6.—6.9 acres—sown 23rd-28th July—received approximately 8 lb cotton dust (10 per cent DDT, 3 per cent g.BHC) per acre on 6th October, 1956, 15th October, 1956, and 22nd October, 1956.
- (b) Field J.7.—6.8 acres—sown 20th-21st July—received 1.5 lb DDT and 0.4 lb g.BHC per acre as low volume spray of nine gallons per acre on 4th October, 1956 and 12th October, 1956.
- (c) Field J.8.—5.5 acres—sown 16th-17th July—received similar spray on 3rd October, 1956 and 11th October, 1956.
- (d) Field J.9.—6.1 acres—sown 13th-14th July—received no insecticide treatment.

(Yields in lb. Seed Cotton/acre, with percentage clean seed cotton taken at each picking)

Field	1st picking 27/11 to 10/12		2nd picking 19/12 to 24/12		3rd picking 21/1 to 24/1		4th picking 18/2 to 25/2		5th picking 11/3 to 15/3		All pickings	
	Yield	Per cent clean	Yield	Per cent clean	Yield	Per cent clean	Yield	Per cent clean	Yield	Per cent clean	Yield	Per cent clean
J. 6	131	85	91	83	12	57	9	45	43	72	285	80
J. 7	163	80	86	87	23	50	15	27	44	80	331	77
J. 8	292	73	116	82	29	43	36	52	105	73	577	72
J. 9	33	43	12	21	12	28	124	86	142	92	323	80

At Daudawa, however, a series of plots planted in mid-June with disinfected seed showed severe damage, with many fruiting branches killed, though later planted plots adjacent showed only moderate attack and there was no apparent spread to other cotton on the farm.

Alternaria, *Ramularia* and *Rhizoctonia* caused only slight damage in general; *Fusarium* and *Verticillium* wilts, virus leaf-curl and *Meloidogyne* rootknot could not be found.

Survival of X. malvacearum

(a) *Survival in trash*.—It is uncertain how much *X. malvacearum* survives in cotton trash over the dry season, and how far this might nullify the effect of seed treatment.

An experiment was therefore laid down to test disinfected and undisinfected samples of eight different seed stocks, each planted with and without the addition to the planting hill of a small handful of infected cotton plant trash. This infected trash had been collected from plots carrying a diseased crop in the previous season and had been stored under cover.

To reduce the risk of cross contamination at planting and to delay the spread from infected seedlings, a double split plot design was used, with trashing versus no trashing in main plots, disinfection versus no disinfection in sub-plots and the eight seed stocks in sub sub-plots.

Counts of diseased seedlings at about five weeks from planting indicated that the seed stocks chosen had covered a wide range of seed-borne infection. The mean percentages shown by plots planted with undisinfected seed and without the addition of trash ranged from 1 per cent for BAR 7/8.1 to 72 per cent for one stock of 26C taken from a heavily infected crop.

The use of Agrosan GN5 as a seed dressing at 1:150 was shown to be very highly effective regardless of the level of the original seed-borne infection in the absence of added trash. Seedling infection was reduced to between 0.06 per cent and 1.5 per cent.

The effect of adding trash was dependent not only on the presence or absence of Agrosan dressing on the seed, but also on the level of original seed-borne infection. Thus if original infection was low and the seed was not dressed, then the addition of trash gave a small increase in infection. If infection was already at a moderate level, then trash apparently added nothing. If infection was at a high level, then trash markedly reduced it.

In the presence of Agrosan the effect of trash was to raise the level of infection markedly when it had originally been low and to restore it to a quite substantial level again when it had been moderate or high before the use of Agrosan.

The addition of trash had other effects than merely presenting a source of infection. It appreciably delayed the emergence of the seedlings, which may be the explanation of its action in reducing the effect of high initial seed-borne infection. However, it is not easy to explain how it could raise the originally low level more in the presence of Agrosan than in its absence.

This trial demonstrated the potential hazard of disease-carrying trash. A second and smaller trial, using the more susceptible variety MU8A, compared trash stored in drums with trash from the same field, but exposed to weathering under 1'' mesh wire netting from 22nd May, just before the first rains, to the day of planting, 24th July. The planting seed had been acid-delinted and stored for twelve months in a screw-stoppered jar. It should, therefore, have been free from blight contamination but would not be protected from seedling infection. The same field was used, with seven ridges per plot, in four replications of three treatments each (weathered trash, stored trash, no trash).

Germination was more even than in the first trial, though trashing still delayed full emergence by a day or two. At eleven days no blight had appeared; at three weeks there was a significant increase for stored trash (2.5 per cent) over control (0.08 per cent), with weathered trash giving 1.2 per cent infection. A count on 28th August of plants with angular leaf spot plus vein blight showed a very highly significant increase for stored debris—43.5 per cent as against 0.66 per cent for weathered debris and 1.2 per cent for control. Figures on 2nd October of plants with vein blight in the three central rows were 36.9 per cent stored, 4.0 per cent weathered and 5.7 per cent control. Final yields from the three central rows showed no significant differences, though the stored trash treatment yielded 16 per cent less than control or weathered trash.

A tentative inference from one season's work is that trash protected from the main effects of weathering may lead to much seedling blight, even after successful disinfection. Full exposure to weathering eliminates this hazard; if rain is the main factor involved, sterilisation of the pathogen might be even more assured in wetter seasons, since, for the period of exposure, this was the driest season for the last thirty-two years.

(b) *Survival on or in the seed.*—An unreplicated observation plot was planted on 14th July with forty-two samples of undisinfected and undelinted seed, from early and late pickings from twenty cotton markets, and early pickings from two others. Planting was completely randomized, with 6'' spacing on single 12 yard ridges. Blight appeared first nineteen days after planting and its incidence at twenty-six days ranged from nil to 46 per cent. A general tendency to higher incidence for seed from early pickings persisted in counts of seedling blight a week later and in angular leaf spot plus vein blight counts at five weeks from planting, after which row to row spread obscured the picture.

Varietal Reactions to Bacterial Blight

Eight varieties were planted in simple randomized blocks, in eight replications of eight three-row plots, at two sites. At the first, following three successive cotton crops out of bush, both the seed and later the stems were inoculated, the trial serving to test methods of inoculation for subsequent

use in large scale cotton breeding at Samaru. At the second site, on clean land half a mile away, there was no inoculation, as it was intended to act as an observational control.

The eight varieties, all of which had suffered a very slight attack of bacterial blight in 1955-56, comprised second wave 26J from Daudawa, and seven varieties from a trial at Samaru, 26C/49130-21, Mai Inchi Allen, 161/25, BAR 7/8.2 (B2B3), Albar 51 (474), MU8A DBCP and BP52 5MB.

Seed was acid-delinted throughout, that for the inoculated site being soaked on 17th July, 1956 in a suspension of *X. malvacearum** and then dried. This site was planted on 20th July, and the non-inoculated site next day, and germination in both was good.

The non-inoculated site virtually escaped infection, few symptoms appearing until the end of September, when a light attack became general. Many plants were diseased, though still lightly, three weeks after the rains ended on 8th October. Albar 51 (474) showed relative susceptibility similar to the other Allen varieties in all phases, while BAR 7/8.2 was highly resistant.

Bacterial blight soon attacked the inoculated site heavily. At twelve days 26J was very highly significantly more diseased (22.8 per cent) than any other (0.1 per cent to 2.7 per cent). Nine days later, 75.3 per cent of 26J seedlings were blighted, compared with 29.4 per cent for BP 52, the next most heavily attacked, 19.2 per cent for Albar 51 and 0.7 per cent for BAR 7/8.2. A similar trend was revealed by grading cotyledon lesions four days later, and by recording the incidence of leaf symptoms (angular leaf spot plus vein blight) at one month from planting.

A record of vein blighted plants after thinning to two plants per stand showed a change in order with 31.4 per cent infection in 26J, 44.2 per cent in BP 52 and 50.0 per cent in MU 8A. Grading for natural angular leaf spot size in mid-September showed that all varieties were very susceptible, including Albar 51 and BAR 7/8.2, though in the latter variety the lesions were few, and confined to the lowest leaves. At this time (14th September) one plant per stand in the central row of three row plots was stem-inoculated by needleprick*, and on 23rd to 26th October a comparative vein blight count was made. For all eight varieties, stem-inoculated plants showed a significant increase; the symptoms were almost certainly not derived from rain-splash infections, and consisted mainly of a fanwise spread of vein blight symptoms from the petiolar union outwards, often extending to the tips. The highest incidence of vein blight after stem-inoculation was on MU 8A, with BP 52 very high, 26C 49130-21 high, 26J, Mai Inchi Allen, 261/25 and Albar 51 (474) moderate and not differing significantly; and BAR 7/8.2 very highly significantly lower than any other. (The trend for plants not stem-inoculated was broadly similar, but at a lower level of incidence).

*G. M. Wickens. E.C.G.C. Research Memoir No. 15, 1953.

Stem reactions were graded on 9th-19th November; as lesions other than those at the points of inoculation were included, a background assessment of uninoculated plants was also made. All varieties suffered highly significantly greater damage from stem-inoculation, with 26J suffering least increase and MU 8A most; the other varieties did not differ significantly between themselves.

During October 3,000 bolls of all eight varieties were tagged at flowering, and the 550 survivors were inoculated by a multi-needleprick method in the second week of November. Over 1,800 two to three day old bolls were sprayed with bacterial suspension at the end of October, and in mid November 1,200 were inoculated with a soft brush dipped in suspension. No boll spotting attributable to inoculation had been seen by 5th-7th December.

Yields showed no certain correlation with disease. The non-inoculated site averaged 605 lb. seed cotton per acre, compared with 331 lb. on the inoculated site.

Conclusions

The initial attack suffered by 26J was by far the greatest, and its disease rating was the highest. This position persisted into the leaf phase, though four other varieties were as high in their rating. Later, 26J showed an increasing tolerance to the disease and its stem resistance was the highest. As the seed came from a different source from that of the other seven varieties, however, it is not certain that it is a true varietal difference, and acid-delinting may have had a differential effect on it.

It is of interest to note that Albar 51 (474), selected at Namulonge for its high level resistance to bacterial blight there, is no more resistant at Samaru than any other Allen derivative. MU 8A and BP 52 started at a level similar to the Nigerian strains, but showed an increasing susceptibility with age of plant, judging by vein blight and stem lesions. BAR 7/8.2 was consistent in its high resistance to all phases except size of angular leaf spot, which was only slightly less on average than all others, though the number of lesions was distinctly fewer on this variety.

The high incidence of vein blight after rains had ceased provides ample evidence of internal vascular spread of the disease, since rain-splash infections could not occur on leaves that developed after the last rain fell.

The techniques of inoculation varied in their response. Seed inoculation was effective, but was probably modified by the previous acid-delinting of the seed (done in order to reduce the seed to a common low level of natural infection). Stem inoculation was much less spectacular, possibly due to higher stem resistance induced by the environment—the plants were extremely woody and it was probably more difficult for stem lesions to develop on them. The observed lesions were almost entirely black necrotic depressions; some showed incipient callusing, and on rare occasions early in their formation water soaking at the margins.

Leaf inoculation by spraying was not tried, as natural infections were plentiful and adequate for disease rating. Boll inoculations were disappointing, but as they were all performed in harmattan conditions after rains had ceased, their failure might be explained by the drying out of bacteria before infection could occur. Such few natural infections as occurred might either have resulted from internal spread or have started during the rains and passed unnoticed.

Effect of Seed Treatment

Disinfection and Inoculated Seed.—Stock 26C was acid delinted, and half was inoculated by three hours soaking in *X. malvacearum* suspension. Each half was then subjected to seed disinfection and planted with controls on 25th July. Germination was good.

On 16th August seedling blight incidence on inoculated plots was between 59 per cent and 73 per cent; uninoculated plots showed 1.6 per cent to 5.7 per cent incidence, and controls 3.0 per cent. Evidently sufficient bacteria penetrated deeply enough into the seed to remain largely unaffected by any further treatment, even with organo-mercurials; a possible explanation of the occasional blighted seedlings produced by seed from a diseased crop even after disinfection.

This experiment was discontinued on noting these results and a further observation plot, randomized but unreplicated, was laid down using 26J seed, naturally and heavily contaminated. Four lots of seed, raw, machine-delinted once, machine-delinted twice, and acid-delinted, were treated with Agrosan GN 5, YF 4303 or YF 4304, at 1:150 respectively, or left untreated as control and planted on 20th August. (The YF 4303 and YF 4304 compounds were similar to Agrosan but containing a deeper dye, rhodamine.)

Germination at twelve days was good; subsequent blight counts at three weeks showed little difference between the disinfected plots (nil-6 per cent), including acid-delinting, while non-disinfected plots yielded 33 per cent to 41 per cent diseased seedlings. These differences persisted a week later, but were gradually confused by secondary spread afterwards.

This unreplicated plot gave the preliminary indication that the modified disinfectants did not noticeably affect either germination or the effectiveness of the bactericide in the presence of either of the two strengths of added rhodamine.

Seed Treatments and Incidence of Bacterial Blight.—This experiment, using 26J seed from a heavily attacked crop, was designed to demonstrate whether seed disinfection with Agrosan GN 5 was affected by the state of the seed, the site, or the time of planting.

Plots at four different sites were planted at a succession of approximately one week intervals. Four states of seed (raw, machine-delinted once, twice, and acid-delinted) were each disinfected with Agrosan GN 5 at 1:150, or left untreated, making eight treatments, which were replicated eight times in randomized blocks at each site.

Site 1 was planted on 14th July, 1956, on land last in cotton in 1949, with groundnuts alternating with guineacorn, maize and cassava since then; the soil was a heavy clay. Site 2 was planted on 9th July, after grass fallow in 1952, cotton in 1953 and 1954 and sunflower in 1955; the soil was a coarse, heavy silt. Site 3, planted on 30th July near a line of mahogany trees, was on an old rotation experiment site, involving cotton, guineacorn, groundnuts and fallow. The soil was a heavy silt in a hollow liable to water-logging. Site 4, planted on 25th July, had carried millet and sunflower in 1953, grazed dhub grass (*Cynodon dactylon*) in 1954, and a cotton insecticide trial in 1955; the soil was a heavy clay with gravel.

Germination at eleven to thirteen days was generally good; treatments did not differ in general vigour of seedlings; at this time a few blighted seedlings were seen in non-disinfected plots in Site 4 only.

Counts of blighted seedlings at sixteen to thirty-two days from planting showed a high level of blight infection in non-disinfected and non acid-delinted plots. Acid-delinting alone reduced incidence to nil in three of the sites, but a few plants were diseased in Site 2, the first to be planted.

Sites 1 and 2 were thinned to 18'' spacing at 2 plants per stand at the end of August; Site 3 was left untouched, and not thinned, weeded or manured, while Site 4 was not thinned, but was weeded and manured with a standard application of fertilisers as in Sites 1 and 2. Site 3 remained stunted, its condition undoubtedly being aggravated by the standing water.

In a count of plants with vein blight in mid September, differences between treatments were reduced, largely because of lower percentages in treatments that had earlier yielded high levels of blight incidence. Site 4 tended to have about half or less the number of vein-blighted plants in the non-disinfected and non acid-delinted treatments compared with Sites 1 and 3. The proportionate damage was greatest in Site 3, while Site 2 was much more heavily attacked than Site 1, though the numbers attacked were similar. This tendency persisted until after rains had ceased, in October, when stem lesions and vein blight predominated.

Finally, no correlation of yield could be obtained with disease incidence or seed state, but Sites 1 and 2 yielded 534 and 644 lb. per acre respectively, while Site 3 yielded 29 lb. and Site 4, 293 lb. Treatments differed significantly only in Site 1 where raw and machine-delinted twice, both non-disinfected, yielded significantly lower than acid-delinted and machine-delinted once, both non-disinfected.

To summarise: factors such as state of seed, time of planting and differences in site did not impair the efficiency of seed disinfection as reflected by disease incidence at seedling and young plant stages; acid-delinting was as efficient as Agrosan GN 5 in this respect, and subsequent treatment of plants and spread of blight overrode the effects of disease incidence on final yield.

Examination of bolls for internal bacterial blight incidence.—Five hundred full size green bolls of 26C and 26J were examined for evidence of lint discolouration by *X. malvacearum*. The majority of bolls were quite clean in all loculi; most of those which were discoloured were affected by bollworm damage and accompanying saprophytic infection of the lint. Only one was definitely contaminated by *X. malvacearum*.

Bacterial blight incidence at Daudawa and other centres.—Supervision of the disinfection of seed at the multiplication farm at Daudawa and associated centres was made at intervals during March, 1956. About 270 tons were handled, at a total estimated cost of under 1s per acre of disinfected seed sown, using hand churns and local unskilled labour with two or three experienced overseers in charge.

Areas sown with this seed were only lightly attacked by bacterial blight.

V—Chemistry Section

By

H. Irving, Senior Chemist, T. B. Miller, Biochemist

K. R. Middleton, Agric. Chemist

GENERAL

The main programme of work of the Chemistry Section changed during the year. Fertiliser experiments were handed over to the Agronomy Section and a separate section was formed to deal with Soil Survey work. This left the chemistry section to investigate chemical aspects of plant and animal nutrition.

In addition to the main research projects conducted within the section a considerable service was given to other sections through the analysis of various materials. Samples of grass have been analysed for the Grassland Officer. Groundnuts have been tested for oil content and oxidative rancidity for the Botanist and Mill Engineer, Samaru. Citrus juice submitted by the Botanist has been analysed for acidity and sugar content as a means of assessing ripening qualities. The cyanogenic glucoside contents of cassava roots have been determined to assist the Botanist in selection of varieties. Sugar cane samples have been analysed in order to determine yields from experiments at Maigana. Cattle dips have been tested for the Agronomist, Samaru and Agricultural Officer, Shika.

Samples of irrigation water from Rima Fadama, Sokoto, were received at fortnightly intervals throughout the 1955-56 dry season. These were analysed for sediment, pH, Ca, Na, K, chloride, sulphate and carbonate. These analyses followed the same general pattern which was obtained in the 1954-55 season (ref. 1955-56 Annual Report).

FOLIAR ANALYSIS OF COTTON

There was a distinct visual difference in the colour of cotton foliage in an experiment conducted by the Senior Cotton Breeder, comparing the effect of heavy applications of both superphosphate and sulphate of ammonia to a heavy application of farmyard manure. As the nitrogen and phosphate level was approximately the same in both treatments, a preliminary investigation into the various contents of the cotton leaves was undertaken to ascertain if the level of any particular element was the causative factor in the colour difference. The results of analysis showed that there was a distinct difference in the sulphate level between the two treatments, the level in the fertilised plots being two to three times as great as the dung plot levels which corresponded with the much deeper green colour in the fertilised plots. As a result of this preliminary investigation a more comprehensive foliar analysis programme is planned for the forth coming year.

The number of competent junior staff in the laboratory is still inadequate and the research programme had to be adjusted accordingly. However, the arrival of new equipment such as the Eel Flame Photometer did enable us to carry out analyses which could not be performed before.

DRY SEASON ANIMAL NUTRITION EXPERIMENTS

The problem of supplementary feeding of cattle in Northern Nigeria during the dry season has been studied during the nineteen thirties. These investigations were conducted to find a satisfactory means of supplementing bush grazing using the materials which were readily available in Nigeria. The results illustrate the deficiencies of nutrients which exist in dry season bush pasture.

Supplements which are rich in protein produce a considerable response on animals as judged by live weight. This result is to be expected when one considers the low levels of protein in the bush pasture.

In addition to the change in quantitative composition of the pasture through advanced growth and desiccation which results in a fibrous fodder of low protein and soluble carbohydrate, there is destruction of carotene as indicated by bleaching. This will result in a carotene-deficient diet.

Since carotene is essential to ruminants as a precursor of Vitamin A, a dry season feeding experiment which included carotene supplements in the regime might be considered useful information in formulating dietary supplement. Moreover, there have been reports of blindness amongst cattle on the School Farm at Samaru and the condition was improved by feeding good quality silage.

1957 Dry Season Cattle Feeding Experiment.—The foregoing facts were considered in planning experiments which were conducted during the dry season of 1956-57. One experiment was carried out at Shika where the effect of protein and carotene-rich supplements was studied and another at the Agronomist's Farm at Samaru in which the extent of carotene depletion in the liver was followed.

Shika Experiment.—Thirty White Fulani heifers of age range eighteen to thirty months were selected. These were divided into five similar groups in a randomized manner. The general management of the cattle was as far as possible, similar to that of the remainder of the Shika herd. They grazed from 8.30 a.m. to 5.30 p.m. and were housed in pens overnight. Concentrate was fed in the morning before they were released for grazing. Table 142 gives the composition of concentrate rations.

TABLE 142.—COMPOSITION OF CONCENTRATE RATIONS

Ration	A	B	C	D
*Guineacorn lb./100 lb. ration	77	94	84	100
Blood Meal lb./100 lb. ration	17	—	16	—
Palm Oil lb./100 lb. ration	6	6	—	—
Constituents:—				
S.E. lb./100 lb. ration	85	87	77	80
DCP lb./100 lb. ration	18.7	7.7	18.5	8.2
S.E. lb./100 lb. live weight	0.46	0.48	0.46	0.47
DCP lb./100 lb. live weight... ..	0.101	0.042	0.110	0.048
Carotene mg/100 lb. ration	3300	3300	nil	nil
Carotene mg/100 lb. live weight	19	19	nil	nil

*Yellow Kaura in A and B, White Farafara in C and D.

Yellow guineacorn may be regarded as a minimal source of protein containing 2 mg. carotene per lb. Palm oil is a rich source containing 500 to 600 mg. per lb.

The animals were housed overnight in the adjoining pens. During the first four weeks after grouping, the cattle were allowed to become accustomed to the routine handling and all groups were fed on cotton seed. Fourteen days before the trial commenced all animals were given rinderpest inoculations. This resulted in a pronounced drop in body weight leaving the animals in an emaciated condition.

Four groups (twenty-four animals) were fed carotene and protein supplements according to the following design:

24 basal ration

{

(12) + carotene

(12) — carotene

{

(6) + protein

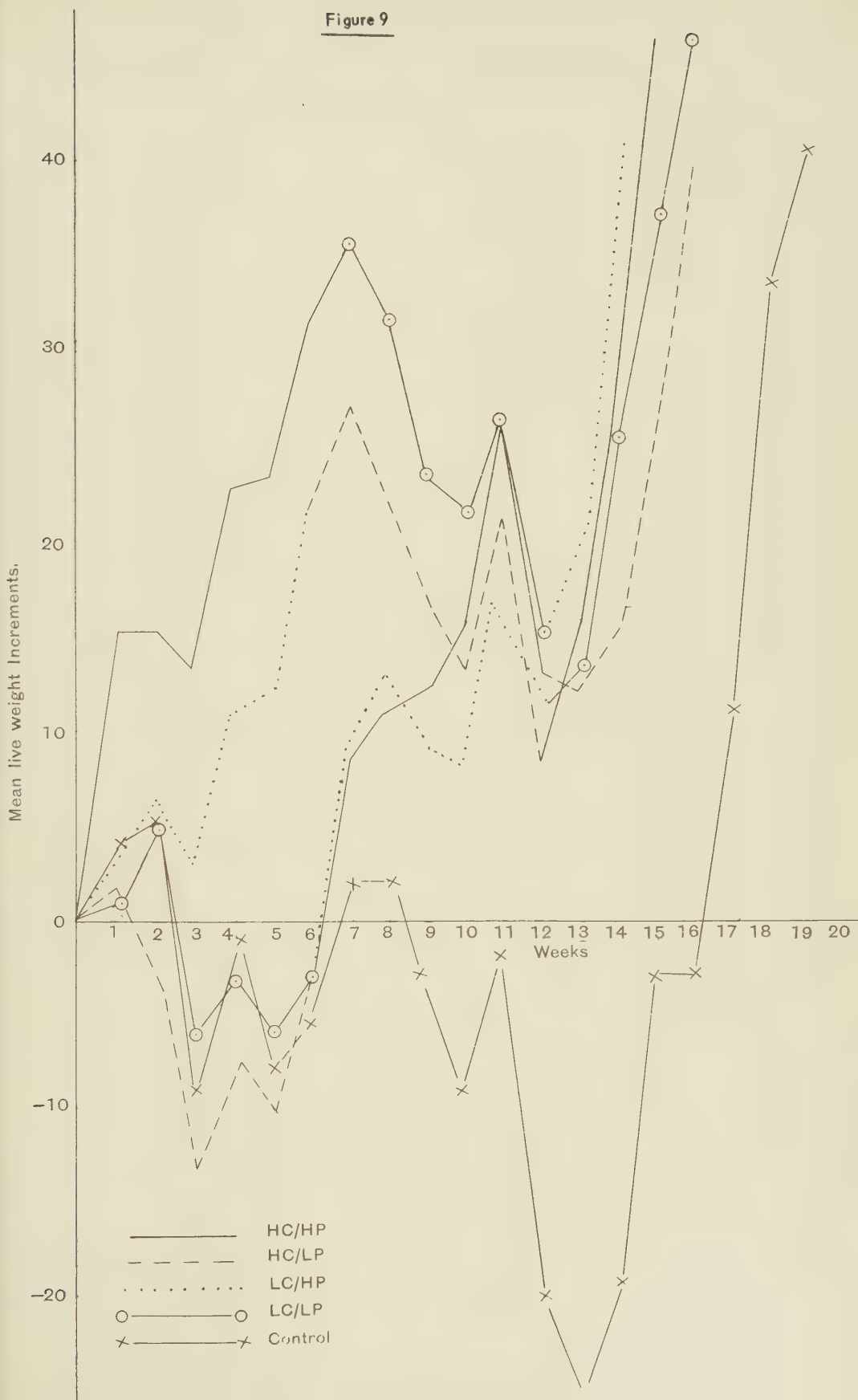
(6) — protein

{

(6) + protein

(6) — protein

Figure 9



Guineacorn formed the basal ration and blood meal the protein supplement. Palm oil was used as the source of carotene. Table 143 shows the feeding arrangements.

TABLE 143.—FEEDING DESIGN

Period								I. 14/1	II. 29/3	III. 8/4	IV. 13/5
Group											
1	...	...	...	...	...	...	...	A	D	C	B
2	...	...	...	...	...	...	...	B	C	D	A
3	...	...	...	...	...	...	...	C	B	A	D
4	...	...	...	...	...	...	...	D	A	B	C
5	...	...	...	...	...	...	...	Control			

Periods I and II were of six weeks duration and III and IV of five weeks. Heavy rain started at the beginning of period III with the resultant growth of green pasture. In anticipation of this sudden change from dry season bush pasture it was considered necessary to have a complete reversal of the rations at the end of period I.

The animals were weighed weekly and samples of blood were taken at the beginning of the experiment and at the end of each period. These were analysed for carotene and vitamin A.

Live Weight Changes.—The weekly mean live weight changes are plotted in Figure 9. During periods I and II the beneficial effect of feeding protein-rich supplement is illustrated. Feeding low protein supplement of similar calorific value has not produced a response which differs noticeably from the control group. Feeding high carotene-high protein would appear better than low carotene-high protein judged from the weight changes in period I. This would lead to the tentative conclusion that feeding carotene is advantageous only when protein is present in sufficient quantity.

Apart from these comparative effects of the respective rations there is the marked change in all groups at the end of period II. This coincides with the first rains of the season when there is a pronounced drop in weight for all groups. The operative factor at this point is presumably the change in roughage ration since all groups have decreased in weight and the control animals have decreased to a greater extent (25 lb. per head) than those receiving concentrate. This effect is probably analogous to the drop in weight

when cattle in temperate regions are released to pasture for the first time after winter feeding. Workers in these countries have demonstrated that the drop in weight is not a true decrease in carcase weight but rather an apparent decrease in live weight because the animal's intake of roughage has decreased. After a short period they become adapted to the change in ration and weight changes follow a normal pattern.

Serum Carotene—Vitamin A levels.—The carotene and vitamin A levels in blood serum after period I and period II are tabulated (Table 144). The effect of feeding carotene—rich supplement resulted in higher levels of the precursor though the vitamin A levels are scarcely increased (Period I, groups 1 and 2). This is not evident in period II.

There was no conclusive evidence of vitamin A deficiency as judged by clinical symptoms. It would appear from these results that carotene is not an important factor in dry season supplementary feeding for animals of this age group (eighteen to twenty four months). Although the bulk of the roughage ration is virtually carotene-free, there were edible green plants available for grazing which provide a source of carotene. Moreover, the storage in the liver from the previous wet season may be sufficient to carry the animals through the dry season.

TABLE 144.—CAROTENE AND VITAMIN A LEVELS IN BLOOD SERUM
(microgrammes/100 ml.)

									<i>Carotene</i>		<i>Vitamin A</i>	
<i>Group</i>									<i>Range</i>	<i>Mean</i>	<i>Range</i>	<i>Mean</i>
1	...	...	...	...	...	...	...	...	38-100	68	2-38	18
2	...	...	...	...	...	...	...	...	51-130	81	2-35	18
3	...	...	...	...	...	...	...	...	25-75	54	6-25	16
4	...	...	...	...	...	...	...	...	25-90	52	6-25	13
5	...	...	...	...	...	...	...	...	26-82	51	1-25	14
1	...	...	...	...	...	...	...	...	41-201	67	20-30	25
2	...	...	...	...	...	...	...	...	31-118	58	12-30	20
3	...	...	...	...	...	...	...	...	41-90	67	15-35	23
4	...	...	...	...	...	...	...	...	50-110	70	3-30	20
5	...	...	...	...	...	...	...	...	80-125	101	16-20	18

THE EFFECT OF CAROTENE VITAMIN A DEPLETION

Information concerning the storage of carotene and vitamin A in the liver and the extent of depletion during the dry season is completely lacking with regard to the cattle in Northern Nigeria. It is obvious that the

importance of carotene supplements in a dry season feeding regime cannot be assessed without this information.

Investigations of this nature are not always possible since they necessitate slaughtering animals. Fortunately a group of bullocks were expendable at Samaru and were used for this purpose.

Fifteen bullocks of age range twelve to thirty-six months were selected and distributed between three similar groups. Three animals were killed at the beginning of the experiment (30-11-56) and samples of liver and blood analysed for carotene and vitamin A. The groups were then given the experimental rations and at the end of fourteen weeks one animal was randomly selected from each group and slaughtered. At the end of the experiment (twenty-eight weeks) another three animals were selected similarly and slaughtered.

Feeding Regime.—The prerequisite of feeding was the control of carotene intake. It was difficult to achieve this by permitting free grazing since sporadic patches of green growth were available. In order to overcome this difficulty the animals were fed with bleached bush grass in the pens.

Concentrate rations were fed as follows:

- A. Carotene free ration.
- B. Low carotene ration.
- C. High carotene ration.

The rations were compounded as shown in Table 145. White guineacorn formed the basis of ration A and Yellow guineacorn was used in rations B and C.

Results.—Liver carotene and vitamin A levels are given in Table 146. The values at the beginning of the experiment were of a high order and would indicate that several months would elapse before serious depletion would become evident depending on the rate of utilization.

Throughout the period of the experiment there were no clinical symptoms of vitamin A deficiency. Before each slaughtering the cattle were tested for night blindness in moonlight and the result in every case was negative.

At the end of the experiment the animal selected from Group A showed almost complete depletion of vitamin A in the liver (Table 146) though there were detectable amounts in the blood stream. The period of depletion is no longer than the duration of the dry season in much of Northern Nigeria, though sporadic patches of green vegetation are often available to the grazing animal during the dry season.

TABLE 145.—COMPOSITION OF CONCENTRATE RATIONS

Group						A	B	C
Guineacorn	lb/100 lb	...	...	...	...	83	83	76
Blood meal	lb/100 lb	...	...	...	...	17	17	19
Palm oil	lb/100 lb	...	...	...	...	—	—	3
Constituents:—								
DCP	lb/100 lb	...	...	...	...	15.04	15.4	19.4
SE	lb/100 lb	...	...	...	...	72	72	88
Ration	lb/100 lb live weight	...	...	...	...	0.75	0.75	0.59
SE	lb/100 lb live weight	...	...	...	...	0.54	0.54	0.52
DCP	lb/100 lb live weight	...	...	...	...	0.116	0.116	0.116
Carotene	mg/100 lb ration	...	...	...	...	nil	166	3000
Carotene	mg/100 lb L.W.	...	...	...	...	nil	1	10

It would be presumptuous to state that carotene is not an important dietary factor in the dry season and that liver depletion rarely or never takes place in the dry season. The animals used in this experiment had always been subjected to a relatively high plane of nutrition and were not typical of the nomadic bush cattle throughout the country. With the latter animals the results may well be similar since there have been reports from America that a low plane of nutrition tends to reduce the utilization of carotene and vitamin A.

TABLE 146.—LIVER CAROTENE-VITAMIN A LEVELS—microgrammes per gramme LIVER DRY MATTER

Weeks		0		14		28	
Group	Ear No.	Carotene	Vitamin A	Carotene	Vitamin A	Carotene	Vitamin A
	201	24.8	104	—	—	—	—
	187	43.8	267	—	—	—	—
	230	30.6	215	—	—	—	—
A	198	—	—	3.5	38	—	—
B	231	—	—	5.4	47	—	—
C	190	—	—	18.0	260	—	—
A	196	—	—	—	—	4.7	1
B	186	—	—	—	—	9.0	54
C	2021	—	—	—	—	11.0	134

SMALL SCALE ENSILAGE TRIALS, 1956

The object of the small scale silage trials is to determine the relative suitability of different materials for ensilage on a commercial scale. These trials are conducted in conjunction with the Grassland Section.

In 1955 six miniature tower silos were built at Shika. These consisted of three 2' by 2' 6" diameter drain pipes cemented together and supported on a concrete base. Two inch metal pipes from the centre of the base to the

outside provided drainage of effluent from each silo. A concrete lid weighing about 1 cwt fits into the silo and slides down with the mass of silage during the compaction.

The silos were filled in October, 1955, using sunflower and soya bean which were in a suitable state for ensilage at that time of the year. These materials are ensiled on a large scale at Shika and invariably produce a satisfactory silage. Using the miniature silos the results were completely unsatisfactory. This can be attributed to improper sealing of the silos after filling. Although a satisfactory fermentation did commence, mould began to grow in the silage and the resulting product was simply a putrified mass.

In 1956 the following materials were ensiled.

1. Grass—*Hyparrhenia rufa*
2. Grass—*Andropogon gayanus*
3. Grass—*Choris gayana*
4. Guineacorn leaves
5. Mucuna—*Stizolobium sp.*
6. Kashin yawo.—*Acanthospermum hispidum*

The materials were chopped by hand into lengths 2-3 inches, weighed in bags, and about 20 lb. packed into the silo at a time. Considerable precautions were taken during filling to ensure anaerobic conditions. A rubber valve was fitted to the drain pipe of each silo. This should prevent the ingress of air and, at the same time, permit the flow of effluent provided there is a sufficient evolution of carbon dioxide to maintain a pressure behind the valve. Cotton lint was placed on top of the mass under the lid.

Table 147 gives the composition of the materials.

TABLE 147.—ANALYSIS OF FRESH MATERIALS ENSILED, 1956

Constituent		<i>H. rufa</i>	<i>A. gayana</i>	<i>C. gayana</i>	<i>Mucuna</i>	<i>G'corn</i>	<i>Kashin Yawo</i>
Ether Extract	...	1.00	0.82	1.40	1.55	3.19	2.06
Crude Protein	...	4.06	6.50	6.31	12.02	13.78	11.88
Crude Fibre	...	34.65	35.15	33.65	40.11	30.55	19.22
Ash	...	22.50	8.70	14.88	14.87	9.75	31.00
N.F.E.	...	37.79	50.83	43.76	31.45	42.69	34.71

HYPARRHENIA RUFA

The grass was in a leafy condition when ensiled and packed easily in the silo. The effluent flow started two days after ensiling and continued for three weeks, by which time 15 litres were collected. During this time the pH decreased from 7.8 to 5.6. This indicated that a slow but fairly satisfactory fermentation had taken place.

The silo was opened four months after filling. The first six inches were inedible because of mould growth and subsequent putrefaction. Below this level a reasonable silage of the brown slightly overheated type existed. There

was evidence of butyric acid and a slightly unpleasant odour. A slight pungency of acetic acid was also present.

During the course of a digestibility trial the silage was sampled. Analysis of the samples indicated considerable heterogeneity with respect to types of fermentation as judged by the range of pH values.

ANDROPOGON GAYANUS

The ensiled material was somewhat stemmy and consequently did not pack as firmly in the tower. There was no flow of effluent.

The spoilage was very high, penetrating to a depth of six inches from the extremities of the entire mass. There was evidence of intense overheating. A very weak fermentation had taken place and there had been favourable conditions for mould growth.

CHLORIS GAYANA

This grass was in the most favourable condition for ensilage, there being a relatively high proportion of leaf to stem. There was no passage of effluent in a measurable quantity.

There was less spoilage than in the case of the other grasses and evidence of a more satisfactory type of fermentation. The silage was greenish brown in colour without obvious signs of over-heating.

GUINEACORN

The guineacorn leaves were pulled off the stalks and chopped before ensilage. This material packed firmly. Although there was no effluent flow the resultant silage indicated that a more favourable ensilage had ensued.

Losses through spoilage were considerably less than with the grass silage. The silage was olive green in colour and readily eaten by sheep.

MUCUNA

Only the leaves and fine stalks were used. There was no flow of effluent and the resultant material was completely inedible. Mould had penetrated the entire mass leaving a semi-putrified undesirable product.

KASHIN YAWO

Ensilage was considered a possible means of utilising this prolific weed. About 3 lb. of the material was ensiled in the laboratory in a Kilner jar. The material was examined after six weeks. The result was a most attractively smelling silage with a pH of 4.6. Moreover the spines, which are alleged to be the cause of the unattractive nature to stock, had softened during ensilage process.

An attempt was subsequently made to ensile Kashin Yawo in a small scale tower at Shika. The plants were pulled by hand, chopped and ensiled in the usual way. The material did not pack easily in the tower and there was no flow of effluent.

After six weeks the silo was opened and the material examined. Mould had penetrated to a depth of about 9 inches from the surface. Underneath this layer a reasonably satisfactory silage resulted.

The small scale ensilage trials which were conducted in 1956 though more successful than the previous year, cannot be considered satisfactory from the viewpoint of assessing the suitability of a material for ensilage. Similar reports have appeared from other workers in the tropics. Workers in the Philippines have declared that it is virtually impossible to obtain satisfactory ensilage with tropical grasses on a small scale.

The following causes probably contribute to the failure:

- (a) The fibrous nature of the materials prevent the exudation of cell juices containing carbohydrate for the production of lactic acid by bacteria. The rather dry season during 1956 probably contributed to this factor. Moreover, the levels of carbohydrate may be low. This inaccessibility of carbohydrate to bacteria would account for the slow initiation of fermentation, and the low effluent production which were evident in all the trials discussed.
- (b) The bacterial flora present on the grasses may be of the wrong type or there may be insufficient lactic acid producing organisms. Since the ordinary process of ensilage depends on the activity of the bacteria present on the grass when ensiled the success of the process is largely a matter of chance.
- (c) There is incomplete exclusion of air which will render unfavourable conditions for the anaerobic bacteria. Furthermore, the atmosphere may contain an abundance of mould spores which find access to the silage mass where the weak lactic acid fermentation presents favourable conditions for mould growth.

The factors (a) and (b) are inherent and can not be overcome in the ordinary process of ensilage. On the other hand (c) presents a practical problem which should not be incapable of solution.

In the 1957 trials which are being planned the above factors have been considered. It is intended to study (a) the effect of adding carbohydrate substrate in the easily obtainable form of guineacorn meal and (b) the effect of adding sodium metabisulphite which will provide immediately satisfactory conditions for lactic acid bacteria. Sodium metabisulphite is becoming increasingly popular as a silage preservative in America and European countries.

DIGESTIBILITY TRIALS

The methods of compiling livestock rations in Nigeria have been based on data derived in other parts of the world. The accuracy of such methods is limited since it is a fallacy to assume that the efficiency of food conversion is the same for ruminants in West Africa as in other parts of the world. The work necessary to evolve data for local conditions was too tedious and time consuming to be attempted with the resources formerly available. Digestibility trials have been started in an effort to obtain the required data. Local sheep

are being used in the first instance. These are housed in crates which provide a means of measuring the feed intake and faeces output.

The first experiments were conducted in June—July, 1956. Difficulties were encountered in handling the animals and designing a satisfactory crate using local materials. Separate receptacles for the collection of faeces and urine from rams did not prove satisfactory—a quantitative recovery of urine was found to be impossible. It was possible, however, to recover the faeces and estimate the feed intake.

Determination of the Digestibility of Elephant Grass (*Pennisetum purpureum*) and Soya Bean hay.

These materials were readily available and were used in the first trials. Six sheep (three rams and three ewes) were used in the trial. All were mature sheep with weights ranging from 50 to 60 lb. and 6 to 8 teeth.

Three sheep were allocated to each ration. The rations were eaten readily from the beginning and it was considered that 14-day observation periods were long enough. During the first four days the animals were allowed to become acclimatised to the rations and feed intake and faeces output were estimated during the remaining ten days. For purposes of analysis two 5 day composite samples of feed faeces were taken.

There were further practical complications in the routine technique of running the trial. It was impossible to adjust the rations so that they were eaten *in toto*. This was particularly evident with the soya bean hay. The sheep selected the leaves and less fibrous stems leaving the thick stems. Consequently the composition of the residue differed considerably from that of the ration feed. It was therefore necessary to sample and analyse both rations and residues and estimate the amount of each proximate constituent eaten and determine the digestibility with the respective constituents in the faeces. It was also impossible to obtain a sample of faeces which was representative of that freshly excreted because of the rapid drying of the faeces in the crate. In order to avoid sampling errors in this way the whole of each twenty-four hour excretion was air dried and sampled after ten days of drying.

The results of the experiment are given in Tables 148 and 149. These are best considered for the two materials separately.

TABLE 148.—SOYA BEAN DIGESTIBILITY DATA

Constituent	per cent	Digestibility Range	Coefft per cent Mean	Digestible Constituent per cent
Dry matter	87.2	62-67	65	56.7
Crude Protein	12.3	49-70	64	7.9
Ether Extract	2.7	40-70	52	1.4
Crude Fibre	31.9	44-65	53	16.8
N.F.E.	44.4	53-78	70	31.0
Organic matter	91.3	57-69	64	58.0

TABLE 149.—ELEPHANT GRASS DIGESTIBILITY DATA

Length Feet			Constituent	per cent	Digestibility Range	Coefft per cent Mean	Digestible Constituent per cent	
12	...	...	...	D.M.	... 22.2	55-68	64	14.2
				C.P.	... 16.0	66-82	74	11.8
				E.E.	... 3.0	62-73	68	2.0
				C.F.	... 33.8	57-72	62	21.0
				N.F.E.	... 32.1	47-73	61	19.6
3-4	...	...	...	O.M.	... 84.9	59-67	64	54.3
				D.M.	... 14.7	66-75	71	10.4
				C.P.	... 18.4	72-82	77	14.3
				E.E.	... 3.1	59-71	67	2.1
				C.F.	... 26.0	64-71	62	16.1
6-8	...	...	...	N.F.E.	... 35.7	73-80	61	21.8
				O.M.	... 83.3	69-75	64	53.4
				D.M.	... 13.0	57-66	62	8.1
				C.P.	... 20.0	71-76	74	14.8
				E.E.	... 3.4	57-66	59	2.0
				C.F.	... 28.6	53-67	60	17.1
				N.F.E.	... 30.4	50-72	63	19.1
				O.M.	... 82.4	63-68	65	53.6

SOYA BEAN HAY

The digestibility coefficients do not give a true estimate of the apparent digestibility of the material as fed but rather of that portion which was eaten. Consequently the values obtained are probably higher than the true values.

The results were obtained from the analysis of ten composite samples of feed and faeces using five sheep—one ewe had to be discarded.

ELEPHANT GRASS

In most cases the grass was eaten *in toto* and where residues had to be analysed they were insufficient to affect the end result. The coefficients may, therefore, be regarded as a true estimate of the apparent digestibility.

The results have been separated according to the different stages of growth of the elephant grass. The results for the tall (12') grass are probably higher in relation to the short material than may be expected. This may be attributed to the fact that the short grass was the aftermath and it is generally found that re-growth of grass is of lower digestibility.

These preliminary trials were not conducted under perfect conditions. Since then the crates have been modified to enable a better collection of excreta and estimation of intake. In 1957 digestibility trials have been conducted with experimental silages,

SOILS

General.—A large number of soil samples have been analysed for the Soil Survey Section. Some samples required only a few determinations whilst other samples, such as typical soil profiles, called for a complete mechanical and chemical analysis.

A number of samples were also analysed for the other Departments such as Forestry and Public Works Department, as well as samples submitted by Agricultural Officers in connection with fertiliser trials.

Nitrate Fluctuation Studies.—In preparation for the soil nitrate fluctuation studies in the various ecological zones of N. Nigeria, a number of currently used methods of nitrate determination were examined for their suitability for the project. The greatest drawback of practically all the methods, especially those of a rapid nature, was their inability to accurately show and reproduce figures in the low range of 0-10 p.p.m. Various modifications were tried out but these did not fulfill our requirements of an accurate, fairly rapid method for routine work with reproducible results.

Further investigations resulted in a new method, based on the well known Greis's Test, which is extremely sensitive giving reproducible results on the lowest range of nitrate content, i.e. 0-5 p.p.m. in an extract.

The new method is used in the study of nitrate nitrogen fluctuations and in the study of mineralizable nitrogen.

VI—Grassland Section

By

A. B. Rains and W. H. Foster

GENERAL

The field activities of the section have been transferred from Samaru to Shika, and the integration of the well established animal section at Shika and the grassland section is being undertaken with the intention of developing animal and pasture research along complementary lines.

With the arrival of additional Senior Staff Officers, it has been possible to start experimental work at Katsina in the Sudan Zone and at Mokwa in the Southern Guinea Zone.

Attention has continued to be given to various aspects relating to the management of sown pastures. It now appears that the effects of a ley on soil fertility are requiring investigation on a considerable scale, and a number of experiments have been started and others designed, to investigate some of these problems of agronomy.

Observations on methods of improving natural rangeland have provided information particularly in terms of grazing and burning but the application of this knowledge in the field presents very formidable difficulties because of the nomadic nature of the cattle owners and the general system of land tenure.

*Middleton, K.R. Colorimetric determination of Nitrate in Water as orange I Chem. and Ind. 1957 pp1147-48.

In view of the integration of the Stock Farm in the Research Station, extracts from the farm's annual report are included in this report. The farm which was started in 1930 consists of nearly 3,000 acres of which 450 acres are cultivated. The aim of the farm has been to improve by breeding and feeding the milk yields of two local breeds of cattle, the White Fulani and the Red Sokoto (or Gudali). At the present time the herd includes 430 White Fulani, 140 Sokoto and 50 cross-bred White Fulani X Sokoto.

The ultimate purpose is to make available to provincial centres, improved stock which can be issued to settled farmers who wish to acquire cattle.

Included in this report are brief descriptions of the activities of the Katsina and Mokwa sub-stations.

Various experiments and investigations which have been completed are described in detail. Others, which are continuing, are not so fully described.

EFFECT OF CUTTING *ANDROPOGON GAYANUS* AT DIFFERENT HEIGHTS

A stand of *Andropogon* sown in 1949 on the Agricultural Department Farm, Kano, was used for this experiment which commenced in 1951.

The grass had been established in rows two feet wide and had been treated uniformly until the start of the experiment.

Treatments were cutting whenever the grass reached a height of 2 feet, 3 feet, 4 feet or 5 feet.

It was continued for three years during which period 12 cuts, 9 cuts, 8 cuts and 7 cuts were taken at the different heights respectively.

Material from the replications was bulked for dry matter and crude protein determinations. Results are presented in Tables 150 and 151.

TABLE 150
Yields of Dry Matter in lb. per acre

<i>Height of cutting</i>	<i>2 ft</i>	<i>3 ft</i>	<i>4 ft</i>	<i>5 ft</i>	<i>Mean</i>
1st year	12,254	13,205	17,259	15,569	14,572
2nd year	7,699	9,433	12,022	13,658	10,703
3rd year	6,461	6,003	6,650	8,037	6,785
Total	26,414	28,641	35,931	37,264	—
Mean ***	8,805	9,547	11,977	12,421	10,686

S.E. Mean ± 87 ...

TABLE 151

Yield of Crude Protein in lb. per acre

<i>Height of cutting</i>	<i>2 ft</i>	<i>3 ft</i>	<i>4 ft</i>	<i>5 ft</i>	<i>Mean</i>
1st year	463	479	453	356	438
2nd year	317	388	442	352	375
3rd year	282	260	277	320	285
Total	1,062	1,127	1,172	1,028	1,098
Mean	354	376	391	343	366
Percentage dry matter	4.02	3.9	3.3	2.8	—

S.E. Mean ± 19

Discussion.—There is no significant difference between the yields of crude protein with the different treatments. The yield of total dry matter is significant (0.1 per cent level) and the difference is almost linear. The less intense the cut the greater is the bulk of material, which is more fibrous and has a lower crude protein percentage.

It is not possible to apply any test of significance to the fall in yields in all the treatments in successive years.

The intensity of cutting is probably the main factor responsible for the drop in yields over the years.

All the yields are greater than are normally obtained from an unmanured stand of *Andropogon gayanus*. These high yields may, to some extent, be due to spacing.

EFFECT OF APPLYING NITROGEN AND VARYING THE FREQUENCY OF CUTTING ON FOUR GRASSES

The experiment was sown down in 1954 at Samaru to test the behaviour of four grasses, *Chloris gayana*, *Hyparrhenia rufa*, *Setaria sphacelata* and *Cenchrus ciliaris* under different cutting frequencies with the application of sulphate of ammonia.

The grasses were established in 12" rows in plots 8 yards by 12 yards. These were split for application of fertiliser and cutting treatment.

In the three seasons the sub plots have been cut eleven or six times using an Allen autoscycyte. The cutting has been at intervals of four or eight weeks during the period of the rains. Half the sub plots have received five dressings of sulphate of ammonia (N) each equivalent to 2 cwt per acre; no other fertiliser was applied.

In setting out the results the yields given for 1956 include a four week cut taken at the end of 1955. This is considered to be desirable in order to keep the plots cut at eight weeks and at four weeks at a comparable stage over the years. Yields of dry matter and of crude protein are given in Tables 152 and 153.

There is a difference in the total productivity of the grasses. *Hyparrhenia* is most productive, followed by *Chloris*, while *Setaria* and *Cenchrus* behave similarly at a lower level.

The application of 10 cwt sulphate of ammonia results in a mean increment of 4,260 lb dry matter per acre, which is a 58 per cent increase, and of 462 lb crude protein, an increase of 98 per cent.

The frequency of cutting had little effect on the yield of crude protein but the less frequent cutting resulted in a mean increment of 1,610 lb dry matter per acre, an increase of 19 per cent, although *Cenchrus* was more productive under the more intense cutting.

TABLE 152
Yield of Dry Matter in lb. per acre

1954	<i>N + 4 weeks</i>	<i>Nil + 4 weeks</i>	<i>N + 8 weeks</i>	<i>Nil + 8 weeks</i>	<i>Mean</i>
Chloris	3,300	3,800	6,050	4,040	4,298
Hyparrhenia	3,720	3,610	5,830	5,480	4,660
Setaria	3,020	2,470	2,360	2,630	2,619
Cenchrus	5,690	3,650	3,370	2,430	3,785
Mean	3,933	3,381	4,403	3,645	3,841
1955					
Chloris	3,370	1,710	5,300	2,400	3,195
Hyparrhenia	4,350	1,930	5,710	3,590	3,895
Setaria	4,180	1,700	5,100	3,510	3,621
Cenchrus	3,560	1,370	3,670	1,570	2,540
Mean	3,865	1,677	4,945	2,766	3,313
1956					
Chloris	2,660	1,400	3,040	1,510	2,150
Hyparrhenia	3,570	2,020	3,490	2,360	2,860
Setaria	2,660	1,450	3,770	1,520	2,350
Cenchrus	2,700	1,300	2,410	1,090	1,890
Mean	2,900	1,550	3,180	1,620	2,310
<i>Total three years:</i>					
Chloris	9,330	6,910	14,390	7,950	9,643
Hyparrhenia	11,640	7,560	15,030	11,430	11,415
Setaria	9,860	5,620	11,230	7,660	8,590
Cenchrus	11,950	6,320	9,450	5,090	8,215
Mean	10,698	6,608	12,528	8,031	9,464

								TREATMENTS		
								Dressings of	Cutting	
								S/A 224 lb./acre	4 week	8 week
1954	...	...	...	...	...	...	...	1	3	2
1955	...	...	...	...	...	...	...	3	4	2
1956	...	...	...	...	...	...	...	1	4	2
Total Three Years S.E. Mean Species $\pm 1,460$										
***Nitrogen		11,613 lb.	...	...	...	...	...	**4 week-cutting 8,553 lb .S.E. ± 414		
Nil		7,320 lb.	...	...	...	...	...	8 week-cutting 10,279 lb.		

TABLE 153
Yield of Crude Protein in lb. per acre

1954					N + 4 weeks	Nil + 4 weeks	N + 8 weeks	Nil + 8 weeks	Mean
Chloris ...	...	...	...	...	357	365	526	322	393
Hyparrhenia ...	...	...	...	...	329	284	295	298	302
Setaria ...	...	...	...	...	287	210	126	182	201
Cenchrus ...	...	...	...	...	422	225	204	144	249
Mean ...	...	...	...	...	349	271	288	237	286
1955:									
Chloris ...	...	...	...	...	338	124	406	92	240
Hyparrhenia ...	...	...	...	...	390	119	423	268	300
Setaria ...	...	...	...	...	405	138	413	136	273
Cenchrus ...	...	...	...	...	320	102	304	69	199
Mean ...	...	...	...	...	363	121	387	141	253
1956:									
Chloris ...	...	...	...	...	258	81	262	60	165
Hyparrhenia ...	...	...	...	...	287	114	222	114	184
Setaria ...	...	...	...	...	260	99	284	88	183
Cenchrus ...	...	...	...	...	236	94	174	79	146
Mean ...	...	...	...	...	260	97	236	85	170
Total Three Years:									
Chloris ...	...	...	...	...	953	570	1,194	474	798
Hyparrhenia ...	...	...	...	...	1,006	517	940	680	786
Setaria ...	...	...	...	...	952	447	823	406	657
Cenchrus ...	...	...	...	...	978	421	682	292	594
Mean ...	...	...	...	...	972	489	911	463	709

Total Three Years S. E. Mean Species ± 93

***Nitrogen		942 lb.	...	...	...	...	**4 week-cutting 730 lb. S.E. ± 49			
Nil		476 lb.	...	...	...	...	8 week-cutting 687 lb.			

METHODS OF ESTABLISHING A RHODES GRASS PASTURE

This experiment was designed to investigate methods of establishing a pasture of Rhodes grass, *Chloris gayana*.

Seed Rates per acre:

Millet	3 feet rows 2 feet spacing 12 lb per acre
<i>Chloris</i>	12" row 4 lb Broadcast 10 lb.
<i>Pennisetum</i>	12" row 1½ lb Broadcast 5 lb.

Plots were grazed at the beginning of October. The average yield of *Chloris* from plots without *P. pedicellatum* was 1,890 lb dry matter per acre; from the plots with *P. pedicellatum*, *Chloris* yielded 887 lb dry matter and the *P. pedicellatum* yielded 928 lb dry matter.

The amount of Chloris available at a second grazing in January, 1956 and an estimation of the percentage cover in April, 1956, using a point quadrat showed no significant difference between treatments.

TABLE 154
Yield of Chloris in lb. Dry Matter per acre (January, 1956)

				Chloris <i>alone</i>	<i>With Millet</i>	<i>With P. Pedicellatum</i>
Manure	...	...	...	920	850	740 (+305 lb. <i>P. pedicellatum</i>)
Nil	...	...	...	800	660	530 (+363 " ")
Rows	...	...	...	1,070	820	540 (+342 " ")
Broadcast	...	...	...	650	690	730 (+326 " ")

TABLE 155

Chloris—*Percentage Cover (April, 1956)*

	Chloris <i>alone</i>	<i>With Millet</i>	<i>With P. Pedicellatum</i>
	per cent	per cent	per cent
Manure	26	21	19
Nil	21	19	18
Rows	21	19	18
Broadcast	26	21	19

A fairly high level of fertility probably minimised the value of the manure. Broadcasting with the higher seed rate produces a better cover with a greater plant population but tends to depress yields.

Eighteen months after sowing there was no visible difference between plots.

GRASSLAND MANAGEMENT TRIAL

This trial was designed to investigate the carrying capacity of the natural grassland at Shikā. Four systems of management have been followed for two years since June, 1955. In three of the systems the land was initially cleared by hand stumping.

Each system or rotation consists of three paddocks of $4\frac{1}{2}$ acres and the aim has been to rear three bullocks, which were approximately $2\frac{1}{2}$ years old at the start of the experiment, on $13\frac{1}{2}$ acres.

The animals have spent approximately two months in a paddock at each grazing.

Treatments:

- I Cleared land—conservation of excess herbage as hay or silage and mowing paddocks after grazing.
- II Cleared land—conservation of excess herbage as hay or silage.
- III Cleared land—no conservation—burning to control scrub.
- IV Uncleared land—no conservation—burning to control scrub.
- V Running with farm stock (*see* below).

A fifth group of bullocks has been running with the farm stock; this group has been housed at night, grazed by herdsman during the day and has received liberal concentrate feeding in the dry season.

At the start of the trial there were accumulated food reserves in the grass, but with the exception of Treatment III these reserves appear to have been seriously depleted during the two years. Burning has not been a satisfactory method of scrub control because of the shortage of combustible material after the requirements of the animal have been met.

It has been necessary to introduce some supplementary feeding during the dry season. Details of this feeding are included in the results.

TABLE 156—GRASSLAND MANAGEMENT TRIAL, SHIKA

<i>Treatment</i>	<i>I</i>	<i>II</i>	<i>III</i>	<i>IV</i>	<i>V</i>
Average liveweight (lb.) 1st June, 1955	543	522	512	586	582
31st May, 1957	745	694	677	682	902
Liveweight gain (<i>a</i>)	202	172	165	96	320
†Concentrates fed per head over two years	165	57	—	678	738
Value of concentrate in liveweight prod. (<i>b</i>) (4 lb.=1 lb.)	41	14	—	169	184
Difference (<i>a</i>)—(<i>b</i>)	161	158	165	73	136

†Concentrates consisted of a mixture of:

Ground guineacorn	Five parts
Groundnut cake	Three parts
Cotton seed	Two parts
Palm kernel meal	Up to Two parts.

The health of the animals has been good throughout the experiment. One animal in Treatment III broke a leg and had to be destroyed and replaced. They have been weighed twice a month during the course of the trial. The record of the weights during the first eighteen months tends to be erratic owing to the adverse effect of giving antrycide prosalt every sixty days.

Discussion.—With the exception of the uncleared land (IV), the different systems appear to have closely similar carrying capacity.

Mowing and making hay or silage has not proved any advantage; this is partly due to the very poor recovery after mowing.

The paddocks in Treatment I have been mown four times in two years, either for hay or silage or topping over after grazing. While it is true that these mowings have kept the scrub, mainly *Isoberlinia doka*, under control it does not seem to have been seriously weakened; the grass however does appear to have been adversely affected by the frequent (?) mowing. Selective grazing combined with mowing has almost completely eliminated the more palatable grasses.

The rate of stocking of one beast to $4\frac{1}{2}$ acres has been too high to allow the use of fire to control scrub regrowth and this regrowth is now a serious problem.

The carrying capacity of the uncleared land compared to the cleared land is probably much lower than is indicated by the results, since the uncleared land is almost denuded of grass.

The danger of depleting the reserves of the herbage by too severe defoliation is associated with a corresponding increase in the scrub.

Another aspect of this trial concerns the economic use of feeding stuff during the dry season in terms of animal production. Workers in East Africa have suggested that during the adverse season the aim should be to provide the minimum necessary to maintain weight and no more.

Other rangeland trials are being conducted to investigate the effect of grazing and burning natural grassland. Mowing treatments are also included on an area initially cleared of scrub by hand stumping. Preliminary observations indicate that a fire at the onset of the rains is of considerable value in the control of scrub, while burning at the beginning of the dry season, as recommended by the Forestry Department, allows the growth of scrub but has an adverse effect on the grass.

Scrub regrowth on cleared land can be effectively controlled by burning or mowing at the beginning of the rains followed by mowing or slashing ten weeks later.

PLANT INTRODUCTION WORK

122 lots of new plant or seed material were introduced during the year. Considerably more work in the collection of indigenous species remains to be done. In the meantime B 48, a selection from *Chloris gayana*, Alego (introduced from Kitale No. 50199), has been multiplied and is being used in trials and experiments requiring a perennial grass. *Stylosanthes gracilis* is similarly filling the gap as a perennial legume. Work has been carried out on the selection of a suitable annual grass. Introductions are still being made but *Pennisetum* spp. will be the principal annual grasses, at least for several years to come.

SEED DISTRIBUTION

555 lots of pasture seed ranging from sample amounts to over 200 lb were distributed through the year. They totalled approximately 1,700 lb.

ANNUAL GRASSES

Annual grasses are of possible use as grazing, hay or silage material in one year leys or self-seeding permanent pasture. Their value is relatively greater in the Sudan Zone where few perennial grass species can persist through the longer dry season. At the present stage of our knowledge, by far the most useful annual grass is "kyasuwa". This Hausa name embraces the section *Brevivalvula* of the genus *Pennisetum*.

Seed from twenty-nine single kyasuwa plants were collected in 1945 in Zaria and Southern Katsina Provinces. This collection covered a wide range of types and, as discovered later, several different species. The collection was gradually reduced on the results of observations and experiments and now (1956) only four are extant. Of these Strain 17 has been identified as *P. polystachyon*, a perennial species, and is not further considered here. The remaining strains, 1, 10 and 21 are described below.

Strain 1. *P. subangustum*, collected on Samaru farm and further selected phenotypically by Junior Staff in 1946.

Strain 10. *P. pedicellatum*, 2-3 spikelets per involucre, collected on Samaru farm.

Strain 21. *P. pedicellatum*, 1 spikelet per involucre, very shortly pedicelled, collected at Daudawa.

The date of flowering has been observed several times with the following results.

TABLE 157
TIMES OF FLOWERING OF KYASUWA STRAINS IN VARIOUS YEARS AT
SAMARU AND KATSINA

Date sown							1-6-46	1-7-48	4-6-53	24-7-56
Centre							Samaru	Samaru	Samaru	Katsina
Strain 1	...	...	...	...	...	...	27 Sept.	2 Oct.	23 Sept.	6 Oct.
Strain 10	...	...	...	...	...	...	21 Sept.	28 Sept.	9 Sept.	29 Sept.
Strain 21	...	...	...	...	...	...	12 Sept.	27 Sept.	4 Sept.	Variable
Local	...	...	...	...	...	...	—	20 Sept.	—	—

Yields have also been measured in several years with the following results.

TABLE 158
Sown 26-6-47, Harvested 5-9-47, Samar

Strain											Green material lb. per acre **
1	...	...	...	...	...	...	...	...	...	...	11,807
10	...	...	...	...	...	...	...	...	...	...	12,870
21	...	...	...	...	...	...	...	...	...	...	14,744
S.E.	...	...	...	...	...	...	...	...	...	...	±902

TABLE 159
Sown 1-7-48, Harvested 4-10-48

Strain											Green material lb. per acre **
1	...	...	...	...	...	...	...	...	...	...	18,282
10	...	...	...	...	...	...	...	...	...	...	16,091
21	...	...	...	...	...	...	...	...	...	...	14,153
Local	...	...	...	...	...	...	...	...	...	...	15,644
S.E.	...	...	...	...	...	...	...	...	...	...	±1,190

TABLE 160
Sown 14-7-56, Harvested 1-10-56, Shika

Strain								Dry matter lb. per acre N.S.	Crude protein	
									per cent	lb. per acre
1	...	...	...	...	...	...	...	2,340	5.5	129
10	...	...	...	...	...	...	...	2,610	5.3	139
21	...	...	...	...	...	...	...	3,210	4.4	141
Kano Collection	...	...	...	...	...	...	...	2,740	4.9	134
S.E....	...	...	...	...	...	...	...	±307		

The main strain difference is thus a difference in earliness, Strain 21 heading about two weeks earlier than Strain 1. There are no constant or large differences in yield, although Strain 21 appears to be the highest yielder of dry matter.

At present the entire involucre of bristles containing one or several spikelets is the unit of "seed" and consequently even distribution at sowing is difficult. However, when machinery becomes available to extract the naked caryopses, it should be simple to design apparatus to sow the seed evenly.

Rottboellia exaltata is a similar indigenous annual species. It grows taller than kyasuwa but has yielded less.

TABLE 161
Sown 14-7-56, Harvested 1-10-56, Shika

					Dry matter lb. per acre *	Crude protein lb. per acre	Crude protein per cent
Average of 4 kyasuwa lots	...	...	...	...	2,725	136	5.0
<i>Rottboellia exaltata</i>	...	...	...	...	1,660	105	6.3
S.E.	...	...	...	...	±371		

The local guineacorn, before flower emergence, is capable of producing a large bulk of protein rich material but there would be great difficulties in persuading the farmers to use their principal grain crop in such a manner.

Eragrostis tef from South Africa is a quick growing and prolific seeding annual. Its use is still undetermined as is that of *Pennisetum setaceum*, an introduction from Dakar somewhat similar to the kyasuwas.

Cenchrus prieurii is of value in the Sudan Zone. Other annuals which have been considered for forage and discarded as unsatisfactory include: *Digitaria iburua*, *Eleusine coracana*, *E. indica*, *Eragrostis tremula*, *E. lehmannia*, *Perotis indica* and *Thelepogon elegans*.

FACTORS AFFECTING THE PRODUCTION OF SEED IN RHODES GRASS

Although other grasses, particularly indigenous species, may prove eventually to be of greater value, in the present initial stages of pasture investigation in Northern Nigeria, Rhodes grass has immediate application. This investigation is concerned with a type selected from our introductions. It is known as the Hay Strain and is characterised by early and profuse flowering with upright and fairly leafy habit. The effects of various manurial and management practices upon seed production are described.

The term, seed, is used in a wide sense to include the whole spikelet less glumes. This consists of the rachilla and attached fertile and sterile flowers. It is in this form that the seed is usually sown.

An experiment, was laid down in 1955 at Shika on fertile land which had been cultivated for a number of years. Treatments were as follows:

- 1955 N₀ Nil.
 N₁ Sulphate of ammonia applied 100 lb per acre on 26th July.
 P₀ Nil.
 P₁ Superphosphate applied at 100 lb per acre on 26th July.
 W₁ Rhodes grass sown in continuous rows 1 foot apart at 4 lb per acre.
 W₂ Rhodes grass sown in continuous rows 2 feet apart at 2 lb per acre.
 C₁ Early mowing (5th August). Seed harvested 11th October.
 C₂ Late mowing (2nd September). Seed harvested 5th November.
 C₃ Seed harvested 21st September. Subsequent mowing (23rd November).
 1956 Sa₁ Sulphate of ammonia applied at 112 lb per acre.
 Sa₂ Sulphate of ammonia applied at 336 lb per acre.
 D₁ Fertiliser applied in one dressing on 29th August.
 D₂ Fertiliser applied in two equal dressings on 14th July and 26th September.

Treatments in 1956 were arranged so that residual effects of all 1955 treatments, except N, could be calculated.

No record was made of the material removed at the early mowing on 5th August, 1955 (Treatment C₁) as at this stage, seven weeks after sowing, the mown material was negligible. All the plots were mown at the beginning of the second season on 19th June, 1956, and no figures for this mowing are included in the results. With these exceptions, plant dry matter and seed yield, where applicable, have been recorded. Recorded mowing dates in 1956 were 21st of August, and 30th October. Results are shown in Tables 162 to 165.

TABLE 162.—1955 SEED YIELD IN LB. PER ACRE
Average yield 275 lb. per acre

Effect of	Compared to	Response	Response in presence of other factors at all levels								
			N ₁	N ₀	P ₁	P ₀	W ₁	W ₂	C ₁	C ₂	C ₃
N ₁ ...	N ₀	+63*	—	—	+56	+69	+47	+78	+100	+17	+71
P ₁ ...	P ₀	—4	—11	+2	—	—	—2	—6	—7	—33	+27
W ₁ ...	W ₂	—28	—43	—13	—26	—30	—	—	—21	—33	—30
C ₁ ...	Av. yield	+44	+94	—6	+41	+48	+33	+54	—	—	—
C ₂ ...	"	—148***	—139	—156	—165	—132	—164	—131	—	—	—
C ₃ ...	"	+104	+139	+68	+117	+90	+89	+119	—	—	—

TABLE 163.—1955 DRY MATTER YIELD IN LB. PER ACRE
Average yield 6,700 lb. per acre

Effect of	Compared to	Response	Response in presence of other factors at all levels								
			N_1	N_0	P_1	P_0	W_1	W_2	C_1	C_2	C_3
N_1 ...	N_0	+1,230	—	—	+1,360	+1,100	+1,010	+1,460	+1,000	+1,970	+730
P_1 ...	P_0	+340	+470	+210	—	—	+340	+330	+460	—290	+850
W_1 ...	W_2	+870	+640	+1,100	+880	+870	—	—	+810	+1,410	+380
C_1 ...	Av. yield	—910	—410	—1,410	—680	—1,140	—500	—1,320	—	—	—
C_2 ...	"	+40	+1,020	—950	—100	+190	+750	—660	—	—	—
C_3 ...	"	+860	+1,230	+500	+1,290	+430	+1,050	+670	—	—	—

No Statistical Analysis performed on these Data due to composite sampling.

TABLE 164.—1956 SEED YIELD IN LB. PER ACRE
Average yield 450 lb. per acre

Effect of	Compared to	Response	Response in presence of other factors at all levels										
			D ₁	D ₂	W ₁	W ₂	Sa ₁	Sa ₂	P ₁	P ₂	C ₁	C ₂	C ₃
D ₁	D ₂	+219***	—	—	+161***	+277**	+237	+200	+223	+215	+147	+240	+270
W ₁	W ₂	—108***	—166**	—50**	—	—	—96	—120	—83	—134	—142	—88	—94
Sa ₁	Sa ₂	+2	+21	—17	+14	—10	—	—	+15	—12	—5	+31	—22
P ₁	P ₂	—23	—19	—27	+1	—47	—8	—37	—	—	—9	—33	—28
C ₁	Av. yield	+25	+98	—48	—46	+96	+23	+27	+20	+29	—	—	—
C ₂	"	—23	+97	—143	—67	+21	—7	—39	—39	—6	—	—	—
C ₃	"	—2	+133	—137	—49	+45	—13	+9	—16	+12	—	—	—

TABLE 165.—1956 DRY MATTER YIELD (SUM OF TWO CUTS) IN LB. PER ACRE
Average yield 6120 lb. per acre

Effect of	Compared to	Response	Response in presence of other factors at all levels.										
			D ₁	D ₂	W ₁	W ₂	Sa ₁	Sa ₂	P ₁	P ₂	C ₁	C ₂	C ₃
D ₁	...	+2470***	—	—	+2260	+2680	+2660	+2270	+2570	+2370	+2290	+2230	+2910
W ₁	...	—370	—580	—160	—	—	—90	—640	—320	—420	—740	+220	—600
Sa ₁	...	+950***	+1140	+750	+1230	+680	—	—	+1130	+770	+1230	+1110	+520
P ₁	...	—120	—20	—220	—70	—170	—70	—290	—	—	+200	—340	—219
C ₁	...	+110	+1250	—1030	—260	+480	+730	—500	+210	+10	—	—	—
C ₂	...	—300	+810	—1410	—190	+410	+250	—860	—470	—130	—	—	—
C ₃	...	+180	+1630	—1270	—120	+480	+440	—80	+80	+280	—	—	—

TABLE 166.—TABLE OF STANDARD ERRORS FOR TABLES 162, 164 AND 165

Comparisons	Standard Error in lb. per acre		
	Table 164	Table 166	Table 167
<i>Main Effects</i>			
N, P.	15.3	24.8	227
W, Sa, D.	10.5	15.2	139
C.	12.8	18.5	171
<i>Interactions</i>			
N/P	22.0	—	—
N/W, P/W, Sa/D	14.8	21.4	197
Sa/W, Sa/P, D/W,			
D/P			
N/C, P/C, C/W	18.1	26.2	242
Sa/C, D/C			

Results

Superphosphate.—In this environment, 100 lb superphosphate per acre produced only small or nil change in dry matter production, seed yield and in phosphate percentage of the herbage.

Sulphate of Ammonia.—Dressings of sulphate of ammonia had a marked effect upon seed yields and dry matter production. In 1956, higher yields were obtained when the dressing of sulphate of ammonia was applied on 29th August, rather than when it was split into two equal dressings on 14th July and 28th September. Dressings of less than $1\frac{1}{2}$ cwt per acre appeared to have little effect upon crude protein percentage of the herbage when it was cut five to ten weeks later.

Spacing.—The effects of spacing are similar to those found in other published results. Sowing the grass on ridges one foot apart did not result in significantly more seed than that obtained from grass sown on ridges two feet apart, although twice as much seed had been used in its establishment. The narrower rows were shown to be of value in dry matter production.

Cutting.—In the year of establishment, a pre-harvest cut caused a large reduction in seed yield (C_2). The trimming (C_1) also depressed seed yields somewhat but in postponing the date of harvest until the rains had ended, it might be considered an advantage.

The low dry matter yield of Treatment C_1 in 1955 was a result of taking only a single cut and this was reflected in the vigorous condition of C_1 plots during the dry season compared to the remaining plots which had been cut twice. The difference in dry matter yield in 1955 between treatments C_2 and C_3 must be balanced against the higher crude protein percentage of the first cut of C_2 .

The residual effects of these cutting treatments may have been masked by the unrecorded early cut in 1956, but on recorded 1956 yields, C_2 appears to have been the most severe.

SUB-STATION—KATSINA

It has been possible to start work during the year on the Veterinary Department's Livestock Improvement Centre near Katsina. This centre is typical of much land in the Sudan Zone of Northern Nigeria. Trees and shrubs include *Guiera senegalensis*, *Piliostigma reticulata*, *Cassia sieberiana* and *Acacia macrostachys*. The grasses are predominantly annual and include *Ctenium*, *Aristida* and *Loudetia* species, also *Pennisetum pedicellatum* and occasional plants of the perennial *Andropogon gayanus*.

A small area of two acres was cleared and observation plots of grasses and legumes established. It is however too early to make assessment of the value of the different species.

An experiment to investigate the productivity of four annual grasses was undertaken but unfortunately a poor establishment invalidated the results.

A second experiment was the application of fertiliser to an established stand of *Andropogon gayanus*.

The fertilisers applied were sulphate of ammonia at six levels and superphosphate at two levels. One purpose of the experiment is to determine the value of artificial nitrogen applied to grass in improving the fertility of the soil for subsequent arable cropping. Treatments and yields are given in Table 167.

TABLE 167.—APPLICATION OF FERTILISER TO ESTABLISHED STAND OF
Andropogon gayanus
Dry matter lb. per acre

<i>Sulphate of ammonia</i>	<i>Nil</i>	<i>2 cwt</i>	<i>4 cwt</i>	<i>6 cwt</i>	<i>8 cwt</i>	<i>10 cwt</i>	<i>Mean</i> * *
Nil	1,300	3,420	3,880	3,520	3,650	2,820	3,070
2 cwt superphosphate ...	1,180	3,760	4,180	5,700	5,400	4,260	4,050
Means ***	1,240	3,590	4,030	4,610	4,530	3,540	3,560

SUB-STATION, MOKWA

A part of this agricultural centre, which was formerly a Colonial Development Corporation project, is now being developed as a Research Station to serve the needs of the Riverain Provinces. A number of observation plots of grasses and legumes have been laid down. Efforts were made to start a productivity trial using five indigenous perennial grasses and Rhodes grass, but difficulties with establishing this trial have prevented the taking of any measurements to date.

EXTRACTS FROM SHIKA STOCK FARM ANNUAL REPORT, 1956-57

The rains started late and were light; 35.3" compared with 43.28", the average for the previous twenty-seven years.

Much of the arable land was badly infested with *Cynodon dactylon*, a result of continuous arable cropping made possible by heavy dressings of farmyard manure.

The whole farm has been completely cleared of scrub as a measure against tsetse fly; control of the scrub regrowth is a major problem. Very few tsetse flies have been caught by weekly fly patrols and a severe dry season appears to have further reduced their number.

Cattle figures showed a decrease from 604 to 602; 281,436 lb. milk were recorded and 120 lactations completed.

Lactations of over 5,000 lb. ...	...	...	...	...	...	2
Lactations of 4,—5,000 lb. ...	...	...	...	...	...	8
Lactations of 3,—4,000 lb. ...	...	...	...	...	...	28
Lactations of 2,—3,000 lb. ...	...	...	...	...	...	45
Lactations of 1,—2,000 lb. ...	...	...	...	...	...	19
Lactations of under 1,000 lb. ...	...	...	...	...	...	18
						120

Of the two animals over 5,000 lb., one was a Shika bred cow which gave 5,406 lb. in her 5th lactation and the other was a half Friesian which gave 5,755 lb. in her 1st lactation and whose dam had averaged 1,350 lb. in three lactations. A summary of herd records is given in Table 168.

Cattle Diseases.—Sixty-five animals were lost as a result of prothidium inoculations, twenty-eight poor animals were sold for slaughter and there were forty-nine deaths from other causes.

The Federal Veterinary Research Department have started a series of investigations on different aspects of animal health and development.

Crops.—A fairly good crop of sunflower (80 acres with yield of 9 tons 6 cwt per acre) was ensiled.

One hundred and thirty-three and a half tons threshed guineacorn was produced from 189 acres.

Sweet potatoes were a poor crop due to inadequate cultivations and weevil damage. Soya bean and *Mucuna (Stizolobium sp.)* grown for hay, gave normal yields.

Sheep.—A new development was the introduction of a small herd of the local sheep. It was intended that they should be used in digestibility trials, in grazing small plots and also provide useful information about a little investigated class of livestock.

Table 168.—SUMMARY OF HERD RECORDS FOR YEAR 1956-57

Breeds—White Fulani and Sokoto
Station—Shika, Zaria, Nigeria

Rainfall 35.32"
Max. Temp.

				Average out-put milk per cow per annum lb.	Lactation record			Average calving interval days	Av. daily yield	
					Recorded lactations no.	Average yield in 305 days lb.	Range in yields lb. and days		During lactation. lb.	Between calvings lb.
Total no. of adult females at 31-3-57										
White Fulani	118	...	...	...	...	1,684				
15 milking heifers plus 103 older females	...	...	...	...	76(a) 79	2,552(a) 2,457	Maximum 5,755 in 305 (b) Minimum 7 in 17	273.0(a) 263.5	9.34	5.72
Sokoto	48	...	...	...	...	1,746				
11 milking heifers plus 37 older females	...	...	...	...	39(a) 41	2,578(a) 2,455	Maximum 4,350 in 313 Minimum 31 in 16	281.0(a) 268.3	9.14	5.88

Notes:

- (a) Lactations of less than fifty days are disregarded in these figures.
- (b) This is the first lactation of a $\frac{1}{2}$ Friesian $\frac{1}{2}$ Fulani. The highest pure bred White Fulani lactation was 5,406 lb. in 305 days. There is also one other $\frac{1}{2}$ Friesian heifer whose lactation is included in the Sokoto herd figures.
- (c) Daily recording.
- (d) Calves weaned at four days.
- (e) 2 x milking, hand or machine.
- (f) Average age at first calving of the twenty-three White Fulani heifers which calved was four years. Average age at first calving of the eleven Sokoto heifers which calved was four years two months.
- (g) Feeding Wet season—concentrates and bush grazing. Dry season.—concentrates and bush grazing, also sweet potatoes, mucuna hay, guinea-corn leaves.
- (h) No correction factors applied to lactation figures.

During the year there have been considerable losses but a number of the deaths followed periods in the digestibility trial crates on a nutritionally inadequate ration.

There was a noticeable loss of condition and several deaths at the end of the rains in October. At this time average adult weight fell from 67 lb. to 55 lb. and this was associated with a worm burden of *Coccidia*, *Strongyloides* and *Moniezia*. Condition improved after dosing with sulphamethazine, and weights have been maintained on range grazing supplemented with some groundnut tops during the dry season.

Male lambs have been weaned satisfactorily at twelve weeks. Weights are recorded weekly for the first twelve weeks and thereafter monthly. Mating is controlled. Four sets of twin lambs were born, but only one of each pair has been reared to weaning.

VII—Soil Survey Section

By

G. M. Higgins

During the second twelve-month period since its initiation the section has benefitted from the arrival of two new officers, Mr A. P. Fleming, Specialist Superintendent (Cartographic Draughtsman) and Mr W. A. Hope, Specialist Superintendent (Soils). In addition it has been possible to enlist the assistance of Mr W. D. Clayton, Federal Ecologist, for the later months of the year, bringing the total strength of the section to four Senior Service officers. Junior Service recruitment has not been as satisfactory but with the proposed training courses during the field off season it is hoped to effect an improvement.

As envisaged, the prime need of the section during the past year continued to be for small scale detailed surveys of Government Experimental Farms followed by rapid road traverses to indicate the provincial areas of which they may be considered typical. In spite of this 'stop gap' priority however, mapping on a reconnaissance scale was commenced at the end of the year in the Mokwa area (Sheet 182 N.W.) the final compilation being at a scale of 1:100,000. In addition, rapid very broad scale ecological surveys were undertaken in Kabba Province (Sheet No. 10), the final scale for the 10,000 square miles completed being 1:500,000.

In all the detailed 'Government Experimental Farm' surveys the procedure was identical, traces being laid out 300 feet apart and inspection points, to a depth of 4 or 5 feet, taken every 200 feet along the trace lengths. Subsequent levelling was carried out using a Dumpy level, all areas being finally contoured at 5 feet vertical intervals. Mile or half mile intervals were employed for siting the inspection points during the road traverses, usually in equivalent topographical positions to that of the farm itself. In the majority of surveys all available roads within a radius of 40 miles from the site were made use of.

The procedure adopted in the reconnaissance survey was similar to that used in the Gold Coast; twenty-five miles of trace or footpath were investigated per 100 square miles of survey area, inspection points being taken every 200 yards along their length. In addition to the soil information, vegetation recordings were made at each chained point together with miscellaneous information such as rock and ironpan outcrops and termite mounds.

Reports on the surveys carried out are described under provincial headings.

ILORIN PROVINCE

Two detailed surveys were undertaken during the year, the normal 'government experimental farm' survey at Ilorin itself and a special detailed survey for irrigated tree crops at Lafiagi.

The soils of the Ilorin site (Latitude $08^{\circ} 30' N$, Longitude $04^{\circ} 33' E$) were found to be derived from Pre-Cambrian coarse granular micaceous gneiss under the influence of an annual rainfall of 50 inches. Three main categories were recognised: (a) shallow reddish brown sandy soils overlying solid, or concretionary above solid, ironpan outcropping as ridges on the higher levels, (b) the middle and lower slope hill creep soils of very variable depth (1 to 8 feet) overlying ironpan, (c) a limited area of deep ironpan-free clay soils to the south, gleyed in the lower lying areas and freely drained on the upper slopes. Subsequent rapid road traverses revealed these soils to be reasonably typical of the northern areas prior to striking the schists and quartzites bordering the Cretaceous sandstones of Mokwa.

At Lafiagi, (Latitude $08^{\circ} 53' N$, Longitude $05^{\circ} 19' E$) conditions proved very different, the site occupying part of the Egwa river flood plain, adjacent to the main Niger flood plain. The soils of the site, developed under a mean annual rainfall of 45 inches, were classified into seven main series dependent upon the type of transported material in which they are developed. The water-logged Agwa and Agwe clay series developed in very fine grained alluvium occupy the lower lying areas and mainly carry the water loving *Sesbania* sp. with a thick ground cover of *Cynodon dactylon* (Pers.). Fine to medium grained alluvia are the parent materials of the Ango and Egwa series carrying a dryer type of vegetation and occupying the major portion of the site. Colluvium from the Lafiagi slope itself forms the parent material of the excessively drained, intensively cultivated Lafiagi series which, when mixed with alluvium in the depression at the base of the slope, gives rise to the waterlogged rice growing Fiagi series. Site, vegetation, soils and proposed land use maps have been completed for this survey at a scale of 1:4,800. The last indicates the suggested sites of blocks for testing the growth of cocoa and kola under irrigated versus non-irrigated conditions both ridged and on the flat.

NIGER PROVINCE

A flood plain area also formed the site of a survey carried out at Wushishi (Latitude $09^{\circ}.44'N$, Longitude $06^{\circ}.06'E$) in Niger Province, the possibilities of crop irrigation again being the main object of the survey. An area of 56 square miles adjacent to the Kaduna river was investigated on a reconnaissance basis. The final vegetation and soil maps were produced at a scale of 1:50,000. Three main geomorphological units were recognised corresponding closely with both soil and vegetation. (A) A gentle undulating stable surface at about 350 feet to 500 feet carrying both *Daniella/Prosopis* coppice and farmland and containing two soil associations (a) that derived from Basement complex and (b) derived from the Cretaceous Nupe sandstones, occurring between the village of Tungan Kawo and mile seventeen across the main Zungeru—Bida road. The geological change was reflected in the occurrence of gravel beds and the change in the nature of the Kaduna river flowing rapidly through a rapids barred gorge at Zungeru, slowing and widening into a drift choked course at Wushishi. (B) The lower old alluvial terrace surface carrying *Daniella/Afromosia* scrub woodland and *Daniella/Terminalia* open woodland. This contains remnants of the sandstone derived association occurring as islands. The terrace itself contains three main alluvial series differentiated on clay contents and degree of mottling. All are compact with imperfect to impeded drainage and crack during long exposure to the sun during the dry season. This is particularly true of the heavier series which are markedly devoid of tree growth and show 'gilgai' formation. Waterlogged during the rainy season they are occasionally used for rice cultivation. (C) The third geomorphological unit, the present day flood plain of the Kaduna river, was not closely examined being subject to flooding during the rainy season and not therefore considered suitable for the project envisaged. On the sandy levees intensive cultivation of sorghum was observed; the lower adjoining areas are grass covered or bare probably depending on the degree of annual flooding rather than soil differences.

At Mokwa (Latitude $09^{\circ}.18'N$, Longitude $05^{\circ}.03'E$) the site of both detailed and reconnaissance surveys, information on the soils was already available from a previous rapid small scale survey carried out in connection with the Niger groundnut scheme. Detailed examination of the soils of the 700 acre experimental farm site showed them to be very similar to those described by Vine (1) as the Kulfo series occurring in large areas to the north-west. The series is derived from the underlying soft coarse grained sandstone of assumed Cretaceous age and consists of about 8 inches of coarse sand merging into approximately 9 inches of loamy coarse sand through a sandy loam into a clay loam to at least 8 feet. Over more than 70 per cent of the area the clay loam horizon occurs between 12 and 24 inches. Beyond these limits, shallow and deep phases were recognised but were not considered as mappable units on the scale of grid employed. Small sample areas investigated showed that they could be mapped with accuracy on a 100 by 150 foot grid. Small isolated patches of heavier soils (clay), similar in

colour, were also recognised, the possibility of their profile development in old termite mounds, abundant in the area, being considered. Investigation into their occurrence and derivation are continuing. Colour of the Kulfo series within the experimental farm area was remarkably constant merging from reddish brown (5YR4/3) in the surface horizons to red (10YR4/6) in the clay loam. Results of chemical analyses are awaited.

The subsequent reconnaissance survey using the Mokwa-Zugurma track revealed, with few exceptions, Kulfo series soils with no indication of the previously reported plateau ironstone or ferruginised sandstone. Work on the reconnaissance ceased, after completing 25 miles of trace, at the commencement of the annual rains. These average 46 inches.

BENUE PROVINCE

The detailed survey carried out at Yandev experimental farm (Latitude 07°.22'N, Longitude 09°.01'E) showed the soils of the 530 acre site to be derived from the underlying Pre-Cambrian granite under the influence of a mean annual rainfall of 53 inches. The soils of the upper slopes consist essentially of gravelly coarse sands to loamy sands merging through mottled red clay loam horizons into the mottled parent material overlying rotting granite at depth. Lower down the slope these soils merge into the brown and yellow middle slope members of the catena with the clay loam horizons becoming indurated and in certain areas forming iron pan. The lower slope members consist essentially of accumulations of wash material from the upper slopes, including ironpan remnants and concretions, with occasionally their recementation to form a more recent ironpan. Subsequent rapid road traverses showed these soils to be typical of those of the granite country to the east and south-east. They were however not typical of those formed on the Cretaceous formations occupying the remainder (50 per cent) of the Province, the main boundary occurring within a few miles of the farm to the north and west.

KABBA PROVINCE

The main object of the detailed survey of the 800 acre site of the Riverain area School of Agriculture (mean annual rainfall 63 inches) was to delineate the most suitable 500 acre site for tree crop growth in addition to that for arable cultivation and for building sites. The area, situated 2 miles to the north of Kabba town (Latitude 07°.52'N, Longitude 06°.03'E) is dominated by three main topographical features—a tributary of the Osse river flowing S.W. through the centre of the site, high ground to the north east of the area and two large inselbergs occurring in the southern portion of the site. The inselbergs rising to a height of 200-300 feet, are composed mainly of moderately fine-grained granite with intrusions of quartz and syenitic and feldspathic gneiss possibly forming the remains of a metamorphic aureole. Exposures in the stream bed revealed similar granites to those of the inselbergs, forming part of the Pre-Cambrian basement complex shown

in the area by Geological Survey. The soils of the site, to the south east of the main stream, are considered to consist of a thick locally transported mantle derived from the weathering of such a complex. Stone lines occur at approximately 8 feet in the majority of soils, the sedentary material merging into rotting rock below. There is free drainage in these 'mantle' soils which are undifferentiated red to yellowish red clay loams to the stone line with no apparent sign of a profile formation. The overall red colour persists even where such soils occur in the lower lying areas bordering the stream, where they are to some extent enriched by lateral clay wash. The stone lines of these lower lying mantle soils also contain concretionary ironstone gravel derived from the weathering of the separating rim of sedentary ironpan soils corresponding approximately with the 500-550 foot contours. Around the base of the inselbergs, soil development has been influenced by the weathering, in the profile, of boulders and rock fragments from the inselbergs themselves giving rise to a brown light clay enriched with minerals and of high fertility.

To the north west of the stream however conditions change rapidly, the soils of the higher areas being sedentary below 2 feet, derived from weathering of the variable basement complex rock. The conspicuous compact line of large stones separating the sedentary material from the surface transported layers effectively rules out any form of arable cultivation on these soils. Three main soil series were recognised in these higher lying areas being differentiated on the type of sedentary material underlying the stone line. The upper slope member exhibits a dull red clay loam parent material, which with the exception of its high angular quartz content, is very similar to the mantle soils, rotting granitic gneiss being apparent at depth. The parent material in the middle slope soils is slightly mottled, the stone line itself containing ironstone concretions and being even more impenetrable. On the lower slopes grey, yellow and red mottles are apparent below 2 feet, the reds and yellows hardening to presumably eventually form concretions. Between the base of the slope and the stream two further series were recognised, comprised mainly of transported material and containing no compact stone line. They are considered suitable for arable cultivation. Small localised patches of heavy grey waterlogged clay occur within this area, especially where drainage depressions running down the slopes, open out into it. Site and layout, soil series and contour maps at a scale of 1:5,000 are in the course of preparation.

MAP PRODUCTION

Production of maps during the year has been limited as the cartographic staff were needed for contour surveys on the government experimental farms. Nevertheless a total of ten compilations were produced during the twelve month period varying from site and scale from the Mokwa Agricultural Project at a scale of 1:62,500 to the 1:500 plan of the Regional Research Station's offices and laboratories.

VIII—Library

By

P. M. J. Edwards

The Library has been in existence since 1925 but its development has fluctuated with the financial position of the Research Station and the disruption of the war years.

A librarian was appointed in November, 1955, and a general reorganisation of the library was started. The cataloguing equipment did not arrive till May, 1957, so the periodical stock was recorded first on temporary sheets. The Kardex cabinet still has not arrived. The book stock was then catalogued and classified. A sheaf catalogue is used and the U. D. C. (Universal Decimal Classification) was finally chosen as being the most suitable classification for the library. From mid May, 1956, to the end of February, 1957, 1,260 books had been catalogued and 838 pamphlets. A large number of pamphlets remain to be done.

Sixty-seven new periodicals were ordered during 1956, and a further ten in January, 1957; nineteen more are coming free or in exchange for our Annual Report, bringing the total received currently to 187 in January 1957. A periodical index to the more important papers in the journals had been kept for some years but the method of indexing was changed in May 1956, and from then onwards papers have been indexed under author and subject, using the Universal Decimal Classification as for books and periodicals; 350 papers were indexed from June, 1956-February, 1957, inclusive.

Papers asked for by members of the staff which are not available in the library are obtained as reprints from the authors or as photocopies or microfilms from London or the University College, Ibadan. It is hoped to get microcards of the missing issues of the more important journals but the question of the best type of microcard and reader has still to be investigated.

A number of exchanges have been arranged for periodicals and Annual Reports of other agricultural stations and more are being arranged.

A monthly accessions list is issued, listing new books, pamphlets and annual reports.

A full time binder is employed and during the year 406 volumes were bound, nearly all being periodicals; a considerable number of pamphlets were covered and other small repair jobs were done. At present the binding cases are sent out to be lettered but lettering equipment is on order and expected soon.

The library is a member of Aslib (Association of Special Libraries and Information Bureaux) and the West African Library Association and close contact is kept with our two neighbouring libraries, the School of Agriculture and the Nigerian College; the University College of Ibadan Library also helps us in many ways.

APPENDIX I
SUMMARY OF METEOROLOGICAL DATA AT SAMARU UP TO 1956

Month	Rainfall		Days rain		Relative humidity (1)				Air temperature °F (Screen)				Sunshine daily mean (hours) (2)		Open pan evaporation (inches) (3)	
	1956	1924-56 Av.	1956	1938-56 Av.	1956 a.m.	1956 p.m.	1938-56 a.m. Av.	1938-56 p.m. Av.	1956 max.	1956 min.	1938-56 max.	1938-56 min.	1956	1954-56	1956	1954-56
January ...	0.00	0.00	—	0.0	17.4	14.0	30.3	13.9	84.4	54.9	88.6	57.6	9.3	7.48	7.06	7.06
February ...	0.28	0.06	1	0.4	30.2	16.1	28.3	12.9	94.2	61.8	91.8	60.7	9.1	6.47	7.25	7.25
March ...	1.32	0.41	3	1.2	49.6	27.3	37.4	16.2	94.7	68.8	96.1	67.3	7.9	7.35	8.28	8.28
April ...	1.76	1.26	4	3.2	51.3	26.3	56.2	26.6	95.1	67.8	97.3	71.0	8.8	7.40	7.12	7.12
May ...	1.73	5.24	6	10.7	60.2	33.2	74.6	46.3	94.9	69.2	91.8	70.1	9.6	7.83	7.30	7.30
June ...	3.97	6.31	12	12.7	72.2	54.8	82.9	59.2	88.3	66.9	88.0	68.1	8.5	6.09	5.61	5.61
July ...	7.65	8.86	17	16.3	79.1	68.3	87.6	68.8	82.3	65.8	83.5	67.3	5.4	4.67	4.83	4.83
August ...	7.63	11.77	19	20.6	87.3	74.1	89.9	73.0	79.0	65.4	81.9	66.9	3.5	3.63	4.28	4.28
September ...	8.61	8.80	16	16.6	77.7	64.2	86.3	65.0	84.8	65.7	84.9	66.7	6.7	4.91	5.03	5.03
October ...	3.55	1.46	6	4.7	50.7	38.8	77.1	55.3	87.3	62.0	89.0	65.3	9.4	6.40	5.81	5.81
November ...	0.00	0.05	—	0.3	29.4	20.6	43.4	21.7	90.3	59.8	90.1	60.6	10.2	6.28	6.64	6.64
December ...	0.00	0.00	—	0.0	27.2	22.0	30.6	16.5	84.1	57.6	87.9	57.8	9.3	6.25	6.66	6.66
Total ...	36.50	44.22	84	87.1	—	—	—	—	—	—	—	—	—	74.76	75.87	75.87
Mean	—	—	—	—	52.7	38.3	60.4	38.8	88.3	63.8	89.2	64.9	8.1	6.23	6.32	6.32

(1) Since 1953 observations taken at 0900 hours and 1500 hours G.M.T.
Before 1953 observations taken at 0800 hours and 1300 hours G.M.T.
(2) Campbell-Stokes sunshine recorder.

APPENDIX II

LATITUDES, RAINFALLS AND VEGETATION ZONES OF STATIONS
(IN ALPHABETICAL ORDER OF STATION)

Station	Province	Latitude °N	Rainfall (ins.) 1955 Average	Vegetation Zone
Bauchi	Bauchi	10 $\frac{1}{4}$	42.21	N. Guinea Zone
Bida	Niger	9 $\frac{1}{4}$	46.86	S. Guinea Zone
Daudawa	Katsina	11 $\frac{1}{2}$	45.82	N. Guinea Zone
Daura	Katsina	13	30.09	Sudan Zone
Gombe	Bauchi	10 $\frac{1}{4}$	32.29	N. Guinea Zone
Gusau	Sokoto	12 $\frac{1}{4}$	36.58	Sudan Zone
Ilorin	Ilorin	8 $\frac{3}{4}$	61.92	S. Guinea Zone
Kabba	Kabba	7 $\frac{3}{4}$	47.63	Derived Savanna Zone
Kafinsoli	Katsina	12 $\frac{1}{4}$	36.03	Sudan Zone
Kano	Kano	12	39.54	Sudan Zone
Katsina	Katsina	13	35.94	Sudan Zone
Kontagora	Niger	10 $\frac{1}{2}$	56.64	N. Guinea Zone
Maiduguri	Bornu	11 $\frac{3}{4}$	33.82	Sudan Zone
Maigana	Zaria ...	11	49.45	N. Guinea Zone
Mokwa	Niger	9 $\frac{1}{2}$	50.69	S. Guinea Zone
Okene	Kabba	7 $\frac{3}{4}$	58.94	Derived Savanna Zone
Riyom	Plateau	9 $\frac{3}{4}$	53.29	Bauchi Plateau Zone
Samaru	Zaria ...	11 $\frac{1}{4}$	52.97	N. Guinea Zone
Shendam (Lowlands)	Plateau	9	42.87	N. Guinea Zone
Shika	Zaria ...	11 $\frac{1}{4}$	53.52	N. Guinea Zone
Sokoto	Sokoto	13	25.94	Sudan Zone
Yandev	Benue	7 $\frac{1}{2}$	50.47	S. Guinea Zone
Yola	Adamawa	9 $\frac{1}{4}$	38.60	Sudan Zone
Zonkwa	Zaria ...	9 $\frac{3}{4}$	61.41	N. Guinea Zone

(Vegetation Zones as defined by Keay in "Outline of Nigerian Vegetation". Rainfall records as reported by Agricultural Stations)

APPENDIX III

PLANT NAMES IN COMMON USE IN NORTHERN NIGERIA

Acha	...	...	<i>Digitaria exilis</i> (staple grain crop of some hill tribes, particularly on Bauchi Plateau).
Benniseed	...	...	Sesame— <i>Sesamum indicum</i> .
Cocoyam	...	...	<i>Colocasia esculentum</i> , <i>Xanthosoma sagittifolium</i> .
Dauro	...	..	<i>Pennisetum spicatum</i> , transplanted from nursery beds about July-August.
Gamba	...	...	<i>Andropogon gayanus</i> (and occasionally <i>A. tectorum</i>) a large grass, used in planted fallows and found wild as climax species in much of the Region.
Gero	...	...	<i>Pennisetum typhoideum</i> , early planted, harvested at 4-4½ months.
Guineacorn	...	...	Species of grain sorghums.
Kyasuwa	...	...	<i>Pennisetum pedicellatum</i> and other small <i>Pennisetums</i> .
Maiwa	...	...	<i>Pennisetum spicatum</i> : varieties differ from Dauro in being longer season (6 months) and never transplanted.
Millet	...	...	Normally means Gero (<i>P. typhoideum</i>).
Rama	...	...	<i>Hibiscus cannabinus</i> .
Rizga	...	...	<i>Coleus dazo</i> .
Tamba	...	...	<i>Eleusine corocana</i> , finger millet.
Tumuku	...	...	<i>Coleus dysentericus</i> .

APPENDIX IV

NOMINAL ROLL OF ESTABLISHED STAFF 1-4-56-31-3-57

1. ADMINISTRATION AND STATION MANAGEMENT

Senior Service:

J. H. Gisborne, B.A., A.I.C.T.A., Deputy Director of Agriculture (R).
 E. J. Butler, B.A., Assistant Director of Agriculture (R).
 H. Irving, B.S.A., Acting Principal Research Officer.
 J. Henson, Agricultural Superintendent.
 W. T. Gordon-Marshall, Executive Officer.

Junior Service Clerical:

J. A. Olukunle, Chief Clerk, transferred to Kaduna 4-12-56.
 A. Kalu, Assistant Chief Clerk.
 N. C. Okonkwo, Assistant Chief Clerk.
 U. Iroha, First Class Clerk.
 P. O. Ochei, First Class Clerk.
 E. C. Ijoma, Second Class Clerk.
 F. E. C. Okwunze, Third Class Clerk, transferred 1-6-56.
 U. Kalu, Clerical Assistant.
 J. N. Achime, Clerical Assistant, resigned 1-11-56.
 N. O. Kanu, Clerical Assistant.
 J. O. Nwokedi, Clerical Assistant.
 S. N. Dama, Clerical Assistant.
 M. N. Mopa, Ungraded Clerk, appointed 16-3-57.
 B. A. Anyanwu, Temporary Ungraded Clerk, appointed 31-1-56.
 B. I. Adema, Temporary Ungraded Clerk, appointed 22-5-56.
 A. I. Nyager, Temporary Ungraded Clerk, appointed 22-5-56.

Junior Service Technical:

W. Samaila, Assistant Agricultural Officer, Grade I.
 H. I. Chidebe, Field Overseer, Grade II.
 S. H. Aleriwa, Field Overseer, Grade II.
 E. N. Aliyu, Field Overseer, Grade II, appointed 1-11-55.
 S. B. Gidado, Temporary Field Overseer, Grade II, appointed 31-1-56.

Junior Service Artisans:

I. E. Obi, Workshop Foreman.
 J. A. Ugwu, Motor Driver.
 E. Irunato, Motor Driver.
 N. Nwani, Motor Driver.
 Ojo Oturkpo, Motor Driver.
 A. U. Agu, Motor Driver, appointed 1-4-56.

Junior Service Messengers, etc.:

Okon Umo, Telephone Attendant.
 Alilu Zaria, Messenger.
 D. D. Dzer, Messenger.
 J. E. Obani, Messenger.
 D. O. Inyamah, Messenger.
 Mazu Hausa, Messenger.
 Momo Yola, Messenger.
 Audu Maradi, Messenger.
 Madaiki Dogerowa, Messenger, appointed 1-4-56.

APPENDIX IV—*continued*

AGRONOMY SECTION

Senior Service:

- K. A. Watson, B.Sc. Agr. (Syd.), Agronomist.
- J. K. Obi, Specialist Superintendent.
- M. C. Cronin, B.Sc., D.T.A. (T.C.D.) Agricultural Officer, transferred 16-4-56.
- P. R. MacCrimmon, B.Sc. (Agric.) Agricultural Officer, (Aberdeen), arrived 3-8-56.
- B. Woodhead, B.Sc. (Agric.) Agricultural Officer.

Junior Service Technical:

- S. O. S. Nwokeabia, Assistant Agricultural Officer, Grade III
- B. C. Udemezue, Assistant Agricultural Officer, Grade III
- G. N. Ofochebe, Assistant Agricultural Officer, Grade III
- F. U. Onyejekwe, Senior Agricultural Assistant.
- U. I. Offia, Agricultural Assistant, Grade III
- F. C. K. Atuora, Agricultural Assistant, Grade III.
- I. O. E. Emeruwa, Agricultural Assistant, Grade III
- Garba Tafawa, Agricultural Assistant, Grade III.
- N. S. Udum, Agricultural Assistant, Grade III, appointment terminated 1-10-56.
- V. G. Sanda, Agricultural Assistant, Grade III.
- M. Nwadiuba, Agricultural Assistant, Grade III.
- C. I. Okonkwo, Agricultural Assistant, Grade III.
- A. A. Agbakwuru, Field Overseer, Grade II.
- B. O. Ilo, Field Overseer, Grade II.
- C. Agbo, Field Overseer, Grade II.
- M. Kera, Field Overseer, Grade II.
- C. P. Shion, Field Overseer, Grade II.
- M. O. Achiaga, Field Overseer, Grade II.
- S. O. Jado, Field Overseer, Grade II, appointed 1-3-56.
- S. M. Maor, Field Overseer, Grade II, appointed 31-1-56.
- B. O. Ekwena, Field Overseer, Grade II, appointed 31-1-56.
- M. A. Adema, Field Overseer, Grade II, appointed 31-1-56.

3. BOTANY SECTION

Senior Service:

- A. R. Maurer, B.S.A., M.Sc., Senior Botanist.
- Miss E. Harrison, B.Sc., D. Ag. Sc., D.T.A., Specialist.
- C. W. Morgan, B.Sc., Agricultural Superintendent.
- W. R. Wilson, Specialist Superintendent.
- C. Harkness, B.Sc., D. Ag. Sc., D.T.A. (Trin.), Specialist.
- R. E. Wyatt, B.Sc., D.T.A. (Trin.), D. Ag. Sc., Specialist.
- D. L. Curtis, B.Sc., D.T.A. (Trin.), Specialist.
- D. G. Faris, M.S.A., Specialist, arrived 28-12-55.
- J. Rossiter, B.Sc., Specialist, arrived 2-1-57.
- P. S. L. Benton, Specialist Superintendent, arrived 30-3-57.

Junior Service:

- B. O. Agbo, Assistant Agricultural Officer, Grade III.
- Abdul Kaka, Agricultural Assistant, Grade I, transferred 8-11-56.
- C. O. Oniyide, Agricultural Assistant, Grade II, transferred 31-8-56.
- G. E. C. Mbonu, Agricultural Assistant, Grade III.
- F. B. Ndubuka, Agricultural Assistant, Grade III.
- Salihu Abdul, Agricultural Assistant, Grade III, resigned 3-4-56.

APPENDIX IV—*continued*

3. BOTANY SECTION

I. B. Fulani, Agricultural Assistant, Grade III.
 Musa Ringim, Agricultural Assistant, Grade III.
 H. A. Leach, Agricultural Assistant, Grade III.
 L. Akanle, Agricultural Assistant, Grade III, resigned 1-4-57.
 J. M. Dangana, Agricultural Assistant, Grade III.
 A. Udensi, Field Overseer, Grade I.
 U. O. Agbaeze, Field Overseer, Grade II.
 S. O. Osokpor, Field Overseer, Grade II.
 J. U. Nwajagwu, Field Overseer, Grade II.
 E. J. Obayori, Field Overseer, Grade II.
 Sani Adamu, Field Overseer, Grade II.
 Paul Alabi, Field Overseer, Grade II.
 S. B. Adetutu, Temporary Field Overseer, Grade II, appointment terminated 5-10-56.
 J. O. Ocheuje, Temporary Field Overseer, Grade II.
 I. Kuhe, Temporary Field Overseer, Grade II.
 E. Okoronkwo, Laboratory Attendant.
 B. O. Ugwu, Artisan Grade III, Photographer.

4. CHEMISTRY SECTION

Senior Service:

H. Irving, B.S.A., Senior Specialist.
 Dr T. B. Miller, B.Sc., A.R.I.C., Ph.D., Biochemist.
 K. R. Middleton, M.Sc., Agricultural Chemist.

Junior Service:

P. O. Ukaga, Assistant Agricultural Officer, Grade III.
 O. T. Eshett, Senior Agricultural Assistant.
 S. A. Babalola, Agricultural Assistant, Grade III, transferred 7-9-56.
 H. A. Jegede, Agricultural Assistant Grade III.
 M. O. Obiora, Agricultural Assistant, Grade III, resigned 26-3-57.
 J. B. T. Ikyogbor, Field Overseer, Grade II.
 A. U. Ajie, Field Overseer, Grade II, appointed 20-3-56.
 F. O. Ochapa, Laboratory Attendant, resigned 5-9-56.
 J. A. Norhumbe, Laboratory Attendant.

Junior Service Artisans, etc.:

J. Ajayi, Electrician.

5. COTTON SECTION

Senior Service:

(All officers of the Empire Cotton Growing Corporation).
 H. E. King, B.Sc., Dip. Agric., Senior Cotton Breeder.
 D. A. Lawes, B.Sc., Cotton Breeder.
 M. A. Choyce, B.Sc., D.I.C., Senior Entomologist.
 M. G. Emsley, B.Sc., Entomologist.
 H. M. Parker, B.Sc., Plant Pathologist.
 B. J. S. Lee, B.Sc., Cotton Breeder, arrived 27-2-57.

APPENDIX IV—*continued*

5. COTTON SECTION

Junior Service Technical—Cotton Breeding:

- F. Taskar, Assistant Agricultural Officer, Grade I.
- A. O. U. Nnadi, Agricultural Assistant, Grade II.
- F. O. Onwuralonye, Agricultural Assistant, Grade III
- S. N. P. Alisigwe, Agricultural Assistant, Grade III.
- J. T. Ohieku, Agricultural Assistant, Grade III.
- O. Onyejekwe, Agricultural Assistant, Grade II.
- I. S. Lado, Field Overseer, Grade II.
- K. A. Ushe, Field Overseer, Grade II.
- S. J. Aleriwa, Field Overseer, Grade II.
- D. O. Iheanu, Laboratory Attendant.

Junior Service Technical—Entomology.

- R. O. Iregbu, Assistant Agricultural Officer, Grade III.
- A. O. Nkwocha, Agricultural Assistant, Grade III.
- E. U. Anazado, Agricultural Assistant, Grade III.
- A. Ibrahima, Agricultural Assistant, Grade III, transferred 24-3-57.
- P. Odegbe, Agricultural Assistant, Grade III, resigned 1-4-57.
- A. M. Tiohn, Field Overseer, Grade II.
- D. I. Jonah, Field Overseer, Grade II.
- C. O. Idewor, Field Overseer, Grade II.
- S. A. Adeoye, Field Overseer, Grade II, (on contract).
- P. Akidiri, Field Overseer, Grade II, (on contract).

6. GRASSLAND SECTION

- A. Blair Rains, B.Sc., D. Ag. sc., Senior Grassland Officer.
- W. H. Foster, B.Sc., Ag. sc., Grassland Officer.
- Dr B. N. Bowden, B.Sc., Ph.D., Specialist, arrived 16-8-56.
- E.3. Mundy, M.Sc., Agricultural Officer, arrived 10-12-56.

Junior Service Technical:

- J. E. Agbejule, Assistant Agricultural Officer, Grade III, resigned 18-10-56.
- L. E. Iduma, Assistant Agricultural Officer, Grade III.
- S. O. Abodunde, Assistant Agricultural Officer, Grade III.
- J. A. Yuwa, Agricultural Assistant, Grade III.
- E. E. Njoku, Agricultural Assistant, Grade II.
- E. N. Ayinor, Agricultural Assistant, Grade II.
- J. A. Turton, Field Overseer, Grade II.
- Ahmadu Iliya, Field Overseer, Grade II, resigned 1-4-57.
- Yakubu Dirisu, Laboratory Attendant.

7. LIBRARIAN

Senior Service:

- Miss P. M. J. Edwardes, B.Sc.,

Junior Service:

- M. N. Atuonwu, Field Overseer, Grade II.

APPENDIX IV—*continued*

8. SOIL SURVEY SECTION

Senior Service:

- G. M. Higgins, B.Sc., D.Ag.sc., D.T.A., Senior Soil Survey Officer.
- A. P. Fleming, Specialist Superintendent, arrived 30-5-56.
- W. A. Hope, Specialist Superintendent, arrived 25-10-56.
- R. H. M. Van de Graaff, Specialist Superintendent, arrived 28-3-57.

Junior Service:

- L. I. Bosah, Agricultural Assistant, Grade II.
- P. N. W. Ezeuka, Field Overseer, Grade II.
- Adamu Umaru, Temporary Field Overseer, Grade II.
- S. Olagunju, Temporary Field Overseer, Grade II.

9. ENTOMOLOGY SECTION

- W. A. Sands, B.Sc., A.R.C.S., Entomologist, arrived 1-11-56.

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